

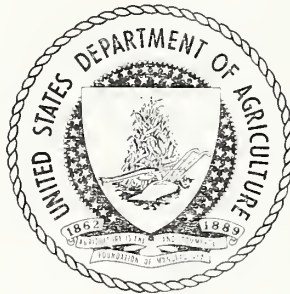
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FOREST SURVEY FIELD INSTRUCTIONS

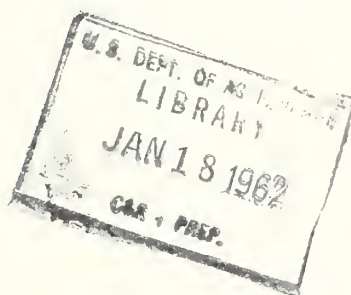
FOR

GROUND SAMPLE PLOTS

IN THE

SOUTH AND SOUTHEAST

Parts One and Three



Prepared by
Division of Forest Economics Research
Southeastern Forest Experiment Station

July 1961

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FOREST SURVEY FIELD INSTRUCTIONS

PART ONE

DEFINITIONS AND SPECIFICATIONS

1 INTRODUCTION

The Forest Survey is a nationwide project having as its purpose the determination, nationally and regionally, and on a continuing basis, of the extent, character, and condition of the forest resource, and of rates of timber growth, mortality, and use.

Responsibility for survey work in Alabama, Arkansas, Louisiana, Mississippi, Oklahoma, Tennessee, and Texas is assigned to the survey unit at the Southern Forest Experiment Station. The Southeastern Forest Experiment Station has responsibility for North Carolina, South Carolina, Florida, Georgia, and Virginia.

Part One of this manual covers definitions and classifications common to the Forest Survey organizations of both stations. Field procedures of the two units differ and are described separately in Parts Two and Three.

2 DEFINITIONS AND CLASSIFICATIONS

To facilitate instructions for classifications of trees, certain standard terms used in discussing classification are defined below.

2.1 Types of Vegetation

2.11 Trees

Woody plants having one erect perennial stem, a more or less definitely formed crown of foliage and ultimately reaching a diameter of at least 3 inches at breast height (4-1/2 feet), and a height of at least 12 feet. The species of woody plants recognized as tree species by the Forest Survey are listed in the Appendix.

2.12 Commercial Species

Tree species presently or potentially suitable for industrial wood products; excludes so-called weed species such as blue beech and sourwood. The species accepted as commercial by the Forest Survey are listed in the Appendix.

2.13 Noncommercial Species

Tree species considered generally unsuitable for industrial wood products within the survey area. Noncommercial species are listed in the Appendix.

2.14 Favored Species

Tree species which should be favored by the forest manager on a specific site. Development of these species represents the most productive timber use on the site concerned. These are species in demand for use in industrial wood

products and whose growth rate is favorable relative to other species occurring on the site. A list of favored species is included in the Appendix.

2.15 Shrubs

Woody plants not classified as trees by Forest Survey. Includes shrubs, brush, and vines.

2.2 Tree Sections

2.21 Diameter (D.b.h.)

D.b.h. is the diameter of a tree measured at breast height, that is, 4.5 feet from the ground level. D.b.h. is measured on the uphill side of trees on slopes. Most trees will be measured at this point. However, in some cases, diameter at this point is abnormal and an approximation of normal d.b.h. is obtained by measurement at another point on the stem.

Naturally swell-butted bottomland trees such as cypress and tupelo are measured at a point 1.5 feet above the end of the pronounced swell (or bottleneck) if the bottleneck is more than 3 feet high.

Normal d.b.h. will be estimated on trees with abnormalities such as wounds, burls, large limbs, or catfaces which would distort direct measurement at breast height.

The diameter of turpentine pines with faces extending above 4.5 feet will be estimated at 10 feet above ground and multiplied by 1.1 for conversion to normal d.b.h.

Occasionally, a sprout or limb becomes the main stem when the original bole is damaged. Diameter will be measured on the new stem if it originates less than 8 feet from the stump of the original bole. If such new stems originate at or above breast height, measurement will be a few inches above the base of the new stem.

Each stem resulting from a fork is considered a separate tree if the base of the fork (not the crotch) is less than 8 feet above the stump. If the fork is below breast height, diameters are measured as usual, otherwise diameter is measured just above the swell that usually extends a few inches above the crotch.

Diameter is recorded (or estimated when above reach) in one-tenth inch classes. The range of diameters included in a one-tenth inch class is illustrated by the following example: The 6.1-inch class includes trees measuring 6.100.... inches but less than 6.200.... inches. One-inch classes are similar. The 5-inch class includes trees measuring 5.000.... but less than 6.000.... inches.

2.22 Stump

The stump ordinarily includes the portion up to 1.0 foot above ground measured on the uphill side. Stump height will be raised slightly to include basal flares or bottlenecks on bottomland species. Stump height should not be increased because of swell resulting from wounds, forks, or other abnormalities.

2.23 Saw Log

A log meeting minimum approved log grade specifications, or, for species for which approved log grades are lacking, meeting regional utilization standards.

2.24 Merchantable Top

The point on the bole of sawtimber trees above which a saw log cannot be produced but not above the following minimum diameters inside bark:

<u>Tree d.b.h.</u>	<u>Minimum top (inches d.i.b.)</u>
9-10	6 (not applicable to hardwoods)
11-12	7 (8 inches for hardwoods)
13-14	8
15-17	9
18-20	10
21-25	11
26 or larger	12

2.25 Saw-log Portion

That part of the bole of sawtimber trees between stump and the merchantable top. Minimum length of the saw-log portion is 8 feet.

2.26 Cordwood Section

That part of the bole of trees 5.0 inches d.b.h. and larger between the stump to a minimum top diameter of 4.0 inches outside bark, or to a point where the central stem breaks up into limbs. In dead-topped live trees this section does not extend above the live portion of the stem.

2.27 Total Height

The straight-line distance in feet from the ground at the base of the tree to the upper tip of the stem.

2.3 Tree Classifications

2.31 Merchantability Class

Sawtimber trees. Live trees of commercial species 9.0 inches and larger in diameter at breast height for softwoods and 11.0 inches and larger in diameter for hardwoods, and containing at least one saw log. Detailed specifications are given in the procedural sections.

Poletimber trees. Live trees of commercial species 5.0 to 9.0 inches in diameter at breast height for softwoods and 5.0 to 11.0 inches in diameter at breast height for hardwoods, and of good form and vigor.

Saplings. Live trees of commercial species 1.0 inch to 5.0 inches in diameter at breast height and of good form and vigor.

Seedlings. Live trees of commercial species less than 1.0 inch in diameter at breast height that are expected to survive according to regional standards.

Growing-stock trees. Sawtimber trees, poletimber trees, saplings, and seedlings, that is, all live trees except cull trees.

Sound cull trees. Live trees that do not qualify as growing-stock trees because of roughness, poor form, or noncommercial species.

Rotten cull trees. Live trees that do not qualify as growing-stock trees primarily because of rot.

To qualify as seedlings, longleaf stems must be at least 0.5 inch in diameter at ground level, other softwoods must be at least 0.5 feet in height, and hardwoods must be at least 1 foot high.

2.32 Crown Class

<u>Code</u>	<u>Crown class</u>
1	<u>Open grown.</u> Large-crowned trees that have developed in the open with little or no competition from the sides. Included are trees in understocked old-field stands and large-crowned wolf tree remnants of former stands.
2	<u>Dominant.</u> Taller than average, getting light from above and from at least three sides, crown well-developed.
3	<u>Codominant.</u> Average height, receiving light from above and from one or two sides, crown usually medium-sized.
4	<u>Intermediate.</u> At least one-half of crown receiving light from above, less than average height, and getting little or no light from sides; crown usually small.
5	<u>Overtopped.</u> Less than one-half of the crown receiving light from above.

2.33 Disease Damage

Each live tree will be classified for the presence or absence of disease infection.

<u>Code</u>	<u>Tree disease</u>
0	None
1	Littleleaf
2	Fusiform
3	Oak wilt
4	Other major disease
5	Littleleaf and fusiform
6	Littleleaf and other major disease
7	Fusiform and other major disease
8	Oak wilt and other major disease

2.34 Insect Damage

Each live tree will be classified for the presence or absence of insect damage.

<u>Code</u>	<u>Insect damage</u>
0	None
1	Southern pine beetle with or without other insects
2	Ips alone or with unlisted insect
3	Black turpentine beetle alone or with unlisted insect
4	Ips and black turpentine beetle with or without unlisted insect
5	Unlisted insect only

2.35 Tree Class

Each tree will be classified on the basis of its past, present, or potential utility and quality into one of six tree classes:

<u>Code</u>	<u>Tree class</u>
	<u>Growing stock:</u>
1	Desirable
2	Acceptable high quality
3	Acceptable low quality
4	Acceptable salvage or sanitation
	<u>Cull:</u>
5	Sound cull
6	Rotten cull

Tree class specifications

Desirable tree, sawtimber-size. Sawtimber trees which meet the following minimum specifications:

Quality

Hardwood trees must have the potential to produce a Grade 2 or better butt saw log within sawtimber rotation. The required grade should ordinarily be present by the time the tree reaches 18" d.b.h. Smaller hardwoods which meet all grade requirements except minimum scaling diameter and which can be expected to meet minimum scaling diameter with further growth are assumed to have the necessary potential. In addition, potential grade of smaller hardwoods may be forecast by ignoring not only minimum scaling diameter but also blind knots, bark distortion, and other defects that may reasonably be expected to disappear with further growth.

Softwood trees must have the potential to produce a Grade 3 butt saw log within sawtimber rotation. The required grade should be present by the time the tree reaches 16" d.b.h. The size and location of limbs and their probable development with further growth will be considered in assessing potential.

Cull - 10 percent maximum board-foot cull in saw-log portion.

Length of saw-log portion - Minimum length required will vary with tree diameter as follows:

Under 14"	- 16 feet
14" - 17"	- 24 feet
18"+	- 32 feet

Life expectancy - at least 10 years.

Vigor - Minimum average annual radial growth.

Pine and hemlock - .08 inch

All other species - .05 inch

General - Tree must be free of serious insect, disease, and mechanical damage. Must have healthy, well-formed crowns. If competing in over-dense stands, must be the most potentially productive of competing trees.

Desirable trees, large saplings and poletimber. Large saplings or poletimber trees with no defect or deformity that will prevent meeting specifications for desirable trees when they reach sawtimber size. Moderate sweep can be expected to diminish with further growth.

Desirable trees, seedlings and small saplings. Seedlings and small saplings are classified for desirability on the basis of species and the site on which they occur. The species and topographic sites are listed in the Appendix. Trees on unproductive forest land can never qualify as desirable trees.

Acceptable high-quality trees. Trees 3.0 inches d.b.h. and larger which meet all requirements for desirable trees except vigor requirements.

Acceptable low-quality trees. Trees which meet all requirements for growing stock but do not meet requirements for desirable trees in respect to one or more of the following: quality, species, cull volume, length of saw-log portion. They may or may not meet the vigor requirements for desirable trees, but must (1) be expected to live for 10 years, (2) not decrease in net volume during the next 10 years, and (3) be free from serious insect or disease infestation. Includes seedlings and small saplings which do not qualify as desirable trees.

Acceptable salvage and sanitation trees. Trees that meet all requirements for growing stock but (1) are not expected to live for 10 years, (2) are expected to decrease in volume in the next 10 years, or (3) are seriously affected by insects or disease. Insects and diseases include, but are not limited to, southern pine beetle, ips, turpentine beetle, oak wilt, little-leaf, fusiform, pitch canker, hispidus canker, and heart rot fungi.

Sound cull trees. Trees that do not qualify for growing stock because of roughness, poor form, or species.

Rotten cull trees. Trees that do not qualify for growing stock because of rot. Also includes small trees which do not qualify as growing stock because of disease infection, and southern pine saplings and seedlings with fusiform infection on the main stem.

2.36 Grade

One or more logs in each live sawtimber tree will be graded. Softwood logs will be graded according to the Southern Pine Interim Log Grades, except that in the Southern Station territory all redcedar logs will be assigned Grade 1. Hardwoods will be graded according to the Hardwood Log Grades for Standard Lumber on the basis of the poorest of the best three faces, and for tie and timber logs. The highest grade for which the log qualifies will be assigned. Grades are included in the Appendix.

2.4 Land Classifications

2.41 Land Use

Land use on the acre within which photo or field plots fall will be classified:

Forest land. Land at least 10 percent stocked by forest trees of any size, or formerly having such tree cover, and not currently developed for nonforest use. Forest trees include both growing-stock and cull trees, including noncommercial species. Seedlings as well as larger forest trees shall be counted in determining stocking.

Does not include lands currently developed for nonforest use such as urban or thickly settled residential or resort areas, city parks, orchards, improved roads.

The minimum area for classification of forest land is one acre. Roadside, streamside, and shelterbelt strips of timber must have a crown width at least 120 feet wide to qualify as forest land. Unimproved roads and trails, streams, and clearings in forest areas shall be classed as forest if less than 120 feet in width.

Various land uses are shown below. The specific classes to be recognized are described in Parts Two and Three.

Commercial forest land. Forest land which is producing or is capable of producing crops of industrial wood and not withdrawn from timber utilization.

Established by natural regeneration

Established by artificial regeneration, usually planting

Noncommercial forest land

Unproductive forest land. Forest land incapable of yielding crops of industrial wood because of adverse site conditions.

Productive forest land withdrawn from commercial timber use through statute or administrative regulation.

Nonforest land. Land that does not qualify as forest land. Includes land that has never supported forests and lands formerly forested where forest use is precluded by development for nonforest uses, such as crops, improved pasture, residential areas, and city parks. Also includes improved roads, and water areas less than 40 acres in area and less than 660 feet wide.

Cropland. Lands cultivated within the past 24 months, orchards being tended, and farm homes and associated yards.

Improved pasture. Land developed for pasture as evidenced by fencing, tree stocking of less than 10 percent, and efforts to establish and maintain a sod of forage species.

Idle or abandoned cropland. Includes cropland and orchards not tended in the past 24 months, abandoned farm home sites, and nonforest land no longer qualifying as improved pasture because of lack of maintenance.

Marsh and prairie. Areas where timber does not grow naturally. Includes low, wet areas characterized by heavy growth of weeds and grasses, and natural prairies or meadows. Abandoned rice paddies which have remained marshy and never restocked with trees are also included.

Urban and other land areas. Nonforest land not qualifying for any other nonforest use. Includes cities, towns, urban parks, suburban residential and industrial areas, school yards, cemeteries, mines, quarries, airfields (including periodically maintained approach strips), railroads, improved roads, clearings at least one acre in size and 120 feet wide, and periodically maintained power line or telephone line rights-of-way on the edges of roads. Extensive areas of forested land within legal boundaries of cities or towns are considered as commercial forest land if not developed for other purposes and available for production of timber.

Non-census water. Bodies of water between one and 40 acres in size and at least 120 feet wide. Portions of larger bodies of water are included when they are between 120 and 660 feet wide.

Census water. Bodies of inland water 40 acres or larger and at least 660 feet wide. Census water area is determined in the office.

2.42 Land Use Difference (or Cause of Change)

Difference in land use found between photo classification and field classification will be classified as follows:

<u>Code</u>	<u>Land use difference</u>
0	No change
1	Land clearing or development for nonforest use since date of photography.
2	Reversion to forest since date of photography.
3	Plots classified as forest on photo and as unproductive forest land in field.
4	Change from one nonforest use to another nonforest use since date of photography. Also include here all plots classified as improved pasture or idle or abandoned cropland by photo interpretation which are oppositely classified in the field.
5	Photo interpretation misclassification. Difference in classification not provided for above.

2.5 Stand Classifications

Current stand classifications such as stocking, stand size, and forest type are based on the classification of 20 stocking units at each plot. Each stocking unit contributes 5 percent to plot stocking. With the 10-point, 2-tree expectancy system, each point has 2 stocking units. A stocking unit may be dominated by a tree of a certain class, size, and species, by other inhibiting vegetation (excludes tree species), or may be unstockable (water, rock, etc.).

Each of the following plot classifications is based on the number of stocking units dominated by the class of vegetation specified, or classed as unstockable.

2.51 Stocking

Current stocking. Current plot stocking in 5 percent classes will be determined for each of the following categories of stocking. Seedlings and saplings are included in these classifications.

Desirable trees

Acceptable trees

Growing-stock trees

Cull trees - Both sound and rotten cull trees are included.

All trees - Total tree stocking.

All pine trees

Other inhibiting vegetation - Includes inhibiting shrubs, vines, etc. Excludes tree species.

Unstockable - Units that will not support tree growth (water, rock, etc.)

Overstocked - Based on points with more than 3 desirable trees. Point weight is 10 percent.

2.52 Stand Size

Current stand size is based on the relative number and size of growing-stock trees stocking the stocking units. The following stand-size classes will be recognized:

Nonstocked areas. Stands less than 10 percent stocked.

Seedling-sapling. Stands at least 10 percent stocked with growing-stock trees with more than half of this stocking in seedlings and/or saplings.

Poletimber stands. Stands at least 10 percent stocked with half or more of this stocking in poletimber and sawtimber trees, and stocking of poletimber trees exceeding that of sawtimber trees.

Sawtimber stands. Stands at least 10 percent stocked with half or more of this stocking in sawtimber and poletimber trees, with sawtimber stocking at least equal to poletimber stocking.

2.53 Forest Type

Current forest types will be determined on the basis of majority of stocking by trees of various species. Both growing-stock and cull trees are used in making this classification. Where no species comprises a majority of a stand, types shall be determined on the basis of plurality of stocking.

The major forest type groups specified in Chapter 4810 of the Forest Service Handbook are shown below. The specific forest types, within these major type groups, of local significance that will be classified in the field are described in Parts Two and Three of these instructions.

Eastern softwood type groups. Forests in which 50 percent or more of the stand is pine, hemlock, redcedar, spruce, or fir, singly or in combination.

White-red-jack pine

Spruce-fir

Longleaf-slash pine

Loblolly-shortleaf pine

Eastern hardwood type groups

Oak-pine. Forests in which more than 50 percent of the stand is hardwoods (usually oaks), cypress, or Atlantic white-cedar, singly or in combination, but in which southern pines or redcedar make up 25-49 percent of the stand.

In the following hardwood type groups southern pines or redcedar make up less than 25 percent of the stand.

Oak-hickory

Oak-gum-cypress

Elm-ash-cottonwood

Maple-beech-birch

Aspen-birch

PART TWO

PROCEDURES IN SOUTHERN STATION TERRITORY

The local needs for information collected by Forest Survey differ somewhat in the Southern Station and Southeastern Station territories. To obtain greatest efficiency, the present survey cycle (the third) must be based also upon data collected and permanent plots established in the previous surveys, which have differed between Stations. For these reasons, field procedures used by the two Stations will differ slightly.

Part Two is not included in the instructions used in the Southeast, nor is Part Three included in those used by the Southern Station.

PART THREE

PROCEDURES IN SOUTHEASTERN STATION TERRITORY

3 ORGANIZATION

3.1 Field Personnel

All field work is directed by a field supervisor. Cruising is done by either 1-man or 2-man crews, depending upon safety aspects, experience and ability of the men, and the availability of transportation. Two-man crews consist of a party chief and a measurer. The party chief directs the work of the crew and is responsible for accuracy and efficiency. The required equipment, maps, photographs, field forms, and supplies are issued to the party chief by the field supervisor.

Survey crews ordinarily work in groups of two or more crews in the same or adjoining counties. In each group of crews, one crew chief is designated as group leader. In addition to his regular duties as crew chief, he is responsible for the efficient operation of the crews as a group. This includes the general planning of the work, selecting temporary headquarters for the crews, directing moves of crews from one temporary headquarters to another, and assisting the field supervisor in follow-up training, obtaining ownership data, and editing field records.

From time to time special studies are made (sec. 10) to supplement the information gathered by the inventory crews. Usually such studies are conducted by Survey field personnel under the direction of the field supervisor, but some may be directed by the Asheville office.

3.2 Equipment and Supplies

3.21 Hand Tools and Instruments

Each field crew is furnished the hand tools, instruments, and light equipment needed on Forest Survey. The party chief signs for the nonexpendable property and is responsible for it. After use in wet weather, diameter tapes and increment borers should be wiped dry and oiled lightly to prevent rusting. The Abney level should be tested periodically for proper adjustment. The painted marks on chains should be touched up or repainted when needed. Carrying cases and sheaths should be kept in good condition to prevent injury to the user and avoid loss. The field supervisor makes property replacements or obtains special repairs as needed. Each crew is expected to keep a full complement of the light equipment listed below maintained in good, usable condition:

1 Abney level with case	1 Kit, tape repair
2 Angle gauge, 37.5 B.A. factor	2 Marker, Syracuse tree
2 Axes, hand, with sheath	2 Protractors, 6-inch
2 Borers, increment	2 Scales, photo
1 Case, ranger's carrying	1 Sheetholder
1 Case, increment core	3 Tapes, diameter, 20-foot
2 Compass, Finnish hand	2 Tapes, 1-chain
1 Holder, Bryan increment core	1 Tape, 2-chain

3.22 Supplies and Record Forms

Each crew is furnished the following supplies, photos, maps, and record forms:

1 First aid kit	Plot tally sheets (previous records and blank sheets)
4 Snake bite kits (Cutters Lab.)	Other report forms (sec. 8)
Accident report forms (sec. 3.34)	Franked envelopes and writing material
Aerial photos (present and previous surveys)	Field instruction manual
Photo index sheets	Aluminum tags (2 sizes)
County maps	Aluminum nails

3.23 Care and Operation of Motorized Equipment

A motor vehicle is assigned to each crew, and provision is made for purchasing gasoline, oil, and other necessary supplies.

It is the responsibility of the crew chief to see that the Jeep or other motor vehicle is properly serviced, inspected periodically, and always kept in safe operating condition. The following schedule of servicing and inspection should be followed:

Lubrication.--A complete lubrication every 1,000 miles or more often where vehicles are operated in unusually wet or muddy conditions.

Maintenance check by operator.--A crew member should make a minor inspection each time the vehicle is lubricated (usually every 1,000 miles). Form E-43-R8, revised 2-1-58, is used. All underlined items on the form are checked. The inspection form is made out in duplicate. The first sheet is sent to the field supervisor who forwards it on to the Asheville office. The second is kept until the next inspection, then sent to the field supervisor along with a copy of the next inspection report.

Change of oil and oil filter.--Change the oil and the oil filter element every 3,000 miles.

Air cleaner.--Clean out and put in new oil every 6,000 miles.

Packing front wheel bearings.--On Jeeps the front wheels should be lubricated as a part of the 1,000-mile lubrication job through a plug that is reached from the outside. Vehicles without 4-wheel drive should have the front wheel bearings packed every 6,000 miles.

Mechanic's inspection.--This inspection is made every 6,000 miles by a competent mechanic. The form used in the maintenance check (Form E-43-R8) is used for this inspection, but the points covered require use of garage equipment and the experience of a mechanic. Items 1 and 2 on the form are checked by a crew member at the time of the mechanic's inspection. The forms are made out in duplicate and handled as for the maintenance check, above.

Vehicle repairs.--Vehicles should be repaired as soon as possible after the need develops. No vehicle in unsafe condition should be operated.

Repairs costing up to \$25 can be made on the judgment of the crew chief. Repairs amounting to over \$25 but under \$100 should be approved by the field supervisor. Repairs costing \$100 or more must be approved by the Asheville office.

An outboard motor is made available to crews for areas where water travel is necessary. Boats are rented locally. An envelope containing instructions for operation and maintenance of the outboard motor should be kept with the motor. The instructions should be followed carefully to avoid loss of time and prevent damage to the outboard motor.

3.3 Safety

All field personnel are subjected to many safety hazards in the course of the different phases of Forest Survey work. Each person always should be conscious of the safety hazards that are present and do his best to prevent accidents. The three sections that follow include suggestions related to the most common safety hazards encountered on Forest Survey.

3.31 Everyday Safety in the Woods

- a. Extreme care should be taken to prevent eye injuries while traveling in brushy areas.
- b. Tools and the cases or sheaths for carrying them should be kept in good condition. A loose tool handle may cause an injury, and the sharp edge of a tool exposed through a worn-out sheath may cause a serious cut.
- c. Take care in getting through fences, over fallen trees, up or down rock slides and banks, and in crossing rivers.
- d. Wear proper clothing. This should include boots, trousers of sturdy material, a long-sleeved shirt, and a cap or hat.
- e. Keep your first-aid kit completely supplied, and treat all wounds promptly.
- f. Each field man should take immunization shots for Rocky Mountain spotted fever, typhoid fever, and tetanus. Those who are susceptible to poison ivy would find it profitable to take preventive treatments for it.
- g. Each tool belt has a pouch containing two small snake-bite kits, and each field man is expected to know how to use the snake-bite kits in case the necessity should arise. Special care should be used in picking things up from the ground, and in crawling on the ground in getting under brush or fallen trees.
- h. Each 1-man crew is expected to have temporary headquarters with another crew. A 1-man crew should always leave with the other crew a list of the plots he expects to get during the day and indicate the order in which they will be gotten. One-man crews should not attempt to get plots that are hazardous in any way, as are boat plots, plots in deep water, or plots that must be approached by crossing deep water. One man working alone should be especially cautious about taking chances because it might be several hours before help would arrive in case of serious injury.

3.32 Use of Motor Vehicles

- a. Drivers of motor vehicles are expected to observe all state vehicle laws. This applies also to non-government vehicles that are used on the job and are, therefore, under our supervision. Jeeps are not to be driven at speeds above 50 miles per hour on the better highways. Much lower speeds should be maintained on rough, muddy, or slippery roads.

- b. No vehicle should be used when in an unsafe condition because of faulty brakes, steering gear, etc. Necessary repairs must be made as soon as any unsafe condition develops.

3.33 Use of Boats

- a. Do not use boats that are leaky, too small, or otherwise unsafe.
- b. Do not use boats unless you have a life jacket for each person. The life jacket should be put on before getting aboard and should be worn until you go ashore.
- c. Caution should be used in traveling streams or lakes where there is danger of hitting submerged logs, rocks, etc.
- d. Do not use a rowboat or small outboard motor on swift streams or in exposed water areas where winds may come up and make the surface too rough for safety.

3.34 Reporting Injuries and Accidents

Small injuries such as briar scratches and bruised shins cannot be completely avoided on Forest Survey. Such scratches and abrasions should be treated to prevent infection, but need not be reported. Each cut or other injury should be reported within 48 hours if it is at all serious or if there is uncertainty about the extent of injury. Each automobile accident should be reported immediately. The following two sections show which report forms are to be used. Each report form is self-explanatory. Be sure to get names, addresses, license numbers, signed statements of witnesses, etc., immediately if such information may be needed. Do not accept responsibility for an accident involving a Government vehicle, and do not suggest initiation of claims against the Government. Each employee who operates a Government vehicle should be covered by liability insurance.

a. Reporting personal injuries

The following table indicates the forms that are required in reporting injuries occurring on the job. Other forms are needed to report hernia cases, back injuries, and accidents resulting in 15 days or more of lost time. A list of designated physicians can be obtained from a post office or other Federal office.

Personal Injury	Report Form							
	CA	CA	CA	CA	CA	CA	FC-141	SF
	1	2	3	20	16	17	R8	92
- - - - - <u>Number of copies</u> - - - - -								
Minor injury, no medical expense, no lost time beyond date of accident.	Notify your immediate supervisor. Both injured man and supervisor note injury in diaries.							
Minor injury involving medical expense. No lost time beyond date of injury.	3	2	--	2	3	or 3	or 3	2
Lost-time injuries	3	2	$\frac{1}{2}$	2	3	or 3	or 3	2

$\frac{1}{2}$ CA-3 is not required if date of return to duty is given on CA-2.

b. Accidents involving property damage

The field supervisor will immediately investigate motor vehicle accidents in which private property is damaged, where there are injuries to private parties, serious injuries to Government employees, or substantial damage to Government property. In such cases he will write a detailed narrative report in addition to completing the regular report forms. In case of serious accident or injury, telephone the Asheville office, if the field supervisor cannot be reached. The table below indicates the forms to be used in reporting motor-vehicle accidents. Injuries to Government employees are reported in the regular manner, above.

Extent of Damage	Report Form			
	SF-91	SF-91A	SF-94	SF-95
	- - - - - <u>Number of copies</u> - - - - -			
Damage to Government property less than \$25.00	1	1	1	--
Damage to Government property \$25.00 or more	1	4	4	--
Accidents involving a private party who wishes to make a claim against the Government for injury or property damage	1	4	4	3

4 LOCATING AND ESTABLISHING FIELD PLOTS

4.1 Plot Class

As a general rule, the forest plots sampled in the field are at the plot locations used in the previous forest survey. Relocation of a few of the old plots will not be possible, and a few plots will have to be moved slightly from the original location. In some counties additional plots have been added to the sample to reduce the sampling error. The nonforest field sample will be made up entirely of new plots.

Field procedures are somewhat different on relocated plots than on new plots; and the handling of the data in the office will also differ to some extent. Because of this it is necessary to assign a plot class to each sample plot. These classes and their codes are as follows:

4.11 Old Plot, Same Location - Code 1

This class includes plots reestablished at the original locations. A plot may be given this classification even if the old plot center is not relocated providing that witness trees, sample trees, marked tally trees, or marked borderline trees relocate plot center accurately enough to assure correct reconstruction of the old plot tally. A field sample plot that has changed to nonforest may be given this classification also.

4.12 Old Plot, Location Shifted - Code 2

This class includes plots that are relocated accurately enough to assure correct reconstruction of the old plot tally, but where the center of the new variable plot is shifted to a new location. Plots are shifted from the old location

in certain cases where the old plot overlaps more than one condition of land use, forest type, stand size, or ownership.

4.13 New Plot, Vicinity of Old Plot - Code 3

This class includes forest plots that were a part of the old sample but which cannot be relocated accurately enough to assure correct reconstruction of the old plot tally. Such plots should be given this classification whether or not they are shifted at the end of the predetermined chainage.

4.14 New Plot, Addition to Sample - Code 4

This class includes forest plots added to the sample and not a part of the sample in the previous survey. It also includes plots in the present nonforest sample.

4.15 Old Plot, Cleared Before Date of New Photography - Code 5

Plots in this class are not in the present field sample and ordinarily will not concern the field crews. They are plots that were forest sample plots in the last survey but which were cleared before the date of the photography used in this survey. They will be used in the office as a means of determining a portion of the volume cut since the last survey. Old plots that are retaken in the present survey would be assigned Code 1 if completely cleared. If not completely cleared they would fit one of the first three classes.

Occasionally the photo interpreter will call an old plot Class 5 because the plot center seems definitely included in an area that changed from forest to non-forest before date of the new photography; but he suspects that a portion of the old tally remains alive and on forest land. In such a case the field crew will be asked to check the plot on the ground and tally the timber cut.

4.2 Use of Maps, Index Sheets, and Photos

The field crew is furnished aerial photos for the present and previous surveys, index sheets, and the map for the county to be worked. The field plots to be established have been selected and marked in green ink on the photos. Approximate plot locations are also shown on the county map.

The party chief, with the help of the measurer, should plan the day's work using the photos, the county map, and, where necessary, the index sheets. The work ordinarily should progress across the county making a clean sweep of all plots. However, it is a good policy to pick up groups of wet or difficult plots in nice weather and bypass an area of accessible upland plots to be gotten in bad weather.

The measurer should drive the vehicle, as the party chief acts as navigator in going to the vicinity of the plot. In most cases the county map can be used in traveling to the area covered by the photo. A few plots located near the edge of the photograph may be difficult to approach using the county map. In such cases the index sheet may provide sufficient extra detail to permit the crew to reach the vicinity of the plot without excessive loss of time. In cases where the approach to the photograph containing the plot appears particularly difficult, the photo interpreter tries to furnish complete coverage of the route on extra photos obtained for that purpose.

4.3 Locating Nonforest Plots

The nonforest plots drawn from P.I. classifications of cropland and other cleared land are usually easy to locate. In most cases the crew can walk to the

approximate location of plot center using the photo as a guide. Such an approximate location is sufficient except where one or more of the following conditions exist:

- a. The plot center is close to the boundary line between two different land uses.
- b. The plot is forest or there is a possibility that it has sufficient stocking to qualify as forest.
- c. The plot may contain cutting done in the past three years.

Where one of the above conditions exists, a compass and chain are used to locate plot center. Plot center is permanently established only for those plots that are forest. Neither starting point nor plot center needs to be marked on non-forest plots.

4.4 Locating New Forest Plots

4.41 The Backsight

A backsight is the reference compass reading taken between two points or along a straight line that can be seen both on the ground and on the aerial photograph. It is used to orient the photo in computing the azimuth from one point through another.

A good backsight should be established for the first plot taken on the photo. It can be used for all other plots on the photo. One of the best backsights is a section of a highway that is straight for one-half mile or more. Other possibilities are drainage ditches, edges of fields, two buildings spaced well apart, etc. Railroads and powerlines are not dependable because they may affect the compass. Azimuth of the backsight should be read and recorded to the nearest one-half degree. A line should be drawn along the backsight on the photo (or parallel to it), an arrow should be put at the end of the line indicating the direction of the azimuth, and "B.S." and the degrees of the reading should be written near the line in an area of light tone such as a field.

4.42 Selecting and Marking a Starting Point

The field crew must locate points on the ground designated as sample plots by pin-pricks on the photos. To do this, the crew must pick a point on the ground that can also be seen on the photo in order to compute direction and distance to the plot. This is the starting point. A good choice of starting points is important since it should be close enough to the plot to minimize chaining time, and yet it should be easily relocated now and 6 or 8 years from now. Sometimes more than one starting point should be used for one plot. For example, S.P. #1 might be a pine tree in the fork of a trail and S.P. #2 might be the center of a sawdust pile 30 chains from S.P. #1 but only 2 chains from the plot. Thus, S.P. #2 could be reached rather quickly by running a compass line from S.P. #1. Then the plot could be located precisely by chaining from S.P. #2. It is also a good idea to use more than one starting point where the route to a plot can be most easily dog-legged around a swamp, cliff, or other obstacle.

In most cases an aluminum tag should be nailed to a tree at or near the starting point. The tag should be placed near the ground on the side of the tree that is least conspicuous to the passerby. An aluminum nail is used to attach the tag leaving most of the nail exposed to allow for tree growth. Where the starting point is permanent and very obvious, no tag is used. None should be used on shade trees or other places where it might displease the owner.

A dot should be placed on the photo at the starting point with a fairly sharp pencil, and "S.P." should be written nearby with an arrow pointing to the dot. Notes describing the starting point are entered on the back of the photo with the location notes (sec. 4.44).

4.43 Computing Plot Azimuth and Distance

Compasses used by Forest Survey are graduated to give readings from 0 to 360 degrees increasing in a clockwise direction (NESWN). Azimuth on Forest Survey is the direction measured in degrees east of magnetic north. Readings are made to the nearest one-half degree. Magnetic declination is disregarded.

The azimuth from the starting point through the sample plot is computed as follows (see figures 1 and 2):

- a. Using a protractor and fairly sharp pencil, draw a straight line through the starting point and plot center on the photo. Extend the plot azimuth line to intersect the backsight line, if possible.
- b. If the lines of the backsight and plot azimuth do not intersect on the photo, draw a line perpendicular to the backsight making it intersect the plot azimuth. Use this line as the backsight after adding or subtracting 90 degrees.
- c. Draw an arrow at the end of the backsight line and plot azimuth line to indicate the direction of each line's azimuth.
- d. Measure one of the two angles between these arrows starting from the backsight.
- e. Add the angle to the backsight if measured clockwise, and subtract if measured counter-clockwise. This gives the plot azimuth. The computation can be kept most simple by measuring the angle in the direction that avoids passing through zero azimuth (N).

Distance from the starting point to the plot is measured on the photo using the transparent scale provided. Distance is measured in chains to the nearest .25 chain. The transparent aerial photo scale is calibrated for direct measurements of distances on photos of scale 1/18,000, 1/19,000, 1/20,000, 1/21,000, and 1/22,000. To determine distance on a photo of, say, 1/20,500, measure it with the 1/20,000 scale, then with the 1/21,000 scale. Then add one-half the difference to the measurement with the 1/20,000 scale. Occasionally a photo may be used with scale as high as 1/23,000. In such cases use the 1/20,000 scale and increase the chainage by 5 percent per thousand units of scale change from 1/20,000. Thus, for 1/23,000 scale it would be chainage for 1/20,000 scale X 1.15.

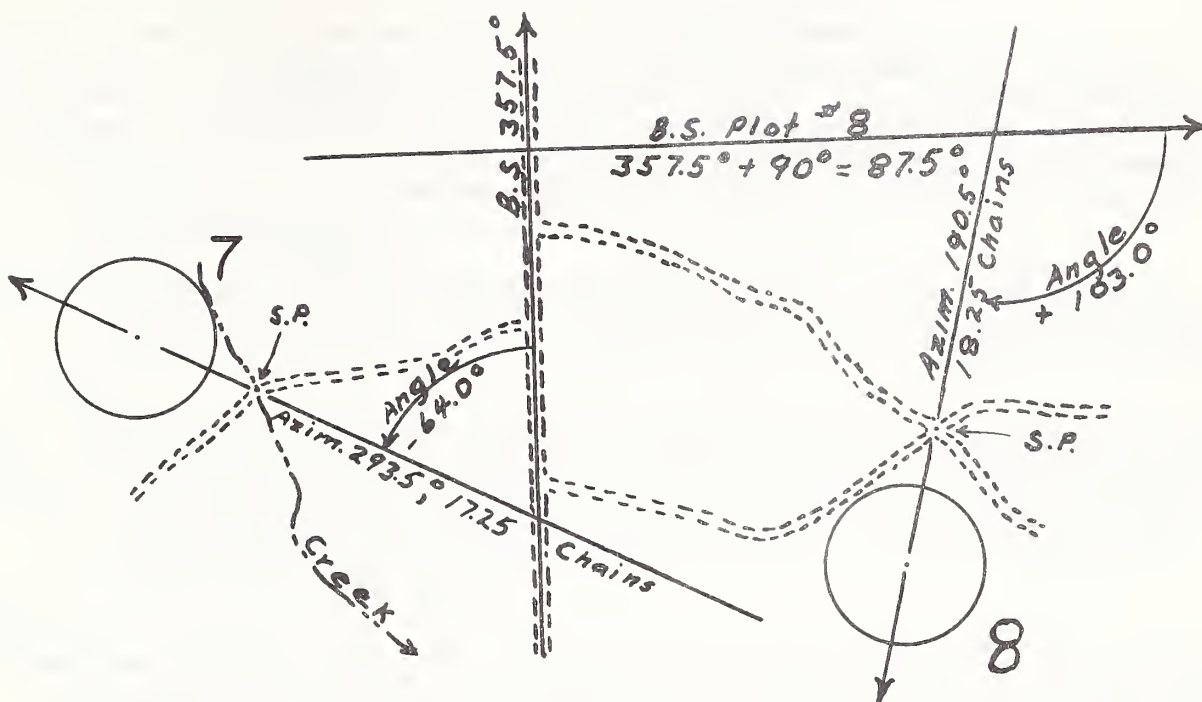


Figure 1.--Front of aerial photograph illustrating the mechanics of determining plot azimuths.

Photo scale 1/20,000			
Plot number	<u>7</u>	:	Plot number <u>8</u>
L.U. class	<u> </u>	:	L.U. class <u> </u>
Ownership	<u> </u>	:	Ownership <u> </u>
Location notes	<u> </u>	:	Location notes <u> </u>
Backsight	<u>357.5°</u>	:	Backsight <u>87.5°</u>
	<u>-64.0°</u>	:	<u>+103.0°</u>
	<u> </u>	:	<u> </u>
Plot azimuth	<u>293.5°</u>	:	Plot azimuth <u>190.5°</u>
Chainage	<u>17.25</u>	:	Chainage <u>18.25</u>
Starting point notes:	<u> </u>	:	Starting point notes: <u> </u>
Start at N end of	<u> </u>	:	Start at center of
concrete culvert where	<u> </u>	:	road intersection.
small creek goes under	<u> </u>	:	Tagged 7" blackgum
road. No S.P. tag.	<u> </u>	:	30 links NW of S.P.

Figure 2.--Reverse side of photo shown in figure 1. Spaces are provided for basic plot information, computing azimuths, and recording of location notes.

4.44 Plot Location Notes

Spaces are provided on the back of the photograph for recording plot location notes (fig. 2). Location notes should include the following:

- a. Backsight
- b. Measured angle between backsight line and plot azimuth line
- c. Plot azimuth
- d. Distance from starting point to plot
- e. Sufficient notes describing the starting point
- f. Notes giving azimuth and distance of any plot shift from the pre-determined location

4.45 Going to the Sample Plot

Field crews chain the distance from the starting point to plot center using a Suunto hand compass and a steel tape. As a safety measure, colored chaining flags are used instead of chaining pins to mark the chainage and keep the chainage tally. On sloping terrain, the slope is measured with an Abney level and slope corrections are made. Slope corrections per chain of distance are listed in the coding summary (Appendix).

4.5 Relocating Permanent Plots

Most of the forest sample plots are permanent plots established in the previous survey. The location notes on the old photographs usually provide sufficient directions for relocating the plot. If clearing or other changes have obliterated the starting point, it may be best to establish another starting point on the new photo and go to the plot in the manner used in locating new plots (sec. 4.4).

Many of the old plots can be relocated by pacing on plot azimuth from the old starting point. With experience, the crew will learn when it is best to walk to the plot without chaining.

4.51 Old Plot Records

The old aerial photograph and the old plot sheet are furnished along with the new photo with the plot transferred to it for each old forest plot to be relocated.

4.52 Starting Point for Old Plots

Starting point notes are listed on the old photo. If the old starting point is good enough to serve for another 6 or 8 years, it should be marked as described in section 4.44 and starting point notes should be recorded on the new photo. Sometimes a witness tree should be used to make the starting point easier to relocate.

Even though the old starting point serves to relocate the plot now, it will often be advisable to replace it on the new photograph with a new starting point that is closer to the plot, is more permanent, or can be found more readily.

4.53 Azimuth for Old Plots

Compasses used by Forest Survey through most of the second survey cycle (through N. C. Unit 1 and N. C. plots for TRR) were set to correct for magnetic declination. For those counties in which magnetic declination was corrected on the compasses, the declinations are listed on the county code sheet (Appendix). Declinations east should be subtracted and declinations west should be added to obtain the azimuths to be used with our Finnish compasses.

In some counties the subtraction or addition of declination will not provide the correct plot azimuth. In such cases, the crew should shoot a few of the old backsights and use the average difference obtained to adjust the old azimuths.

4.54 Relocation of Plot Center

Once the crew has reached the vicinity of the plot, a knowledge of the following establishment procedures used in the last survey, along with the information on the old plot sheet, should enable the crew to locate the old plot center:

- a. Heavy galvanized wire center pins were used.
- b. A metal plot tag, painted yellow and about 2" X 4", was nailed facing plot center and 6 or 7 feet from the ground on a nearby tree.
- c. Two witness trees, described on the old plot sheet, were established on each forest plot. In some cases the tag tree was not one of the witness trees.
- d. Sample trees, with descriptive data listed near the bottom of the old plot sheet, were tagged at the base with numbered aluminum tags.
- e. The locations of the sample trees and the witness trees were plotted on a plot diagram on the back of the tally sheet.
- f. All trees in the tally 5.0 inches d.b.h. or larger were marked with a Syracuse tree marker. The mark was made on plot-center side of the tree above d.b.h. and usually went to the cambium.

4.55 Location Notes for Old Plots

Sufficient location notes should be entered on the back of the new photo to permit relocating the plot without difficulty.

Old plots that were shifted (plot class 2) should have directions for locating the new variable plot, not the old plot.

4.6 Shifting of Plots

Under certain circumstances a new plot is shifted from the point reached at the end of the predetermined chainage; and an old plot may have to be shifted (plot class 2) because of changes that have taken place on or near the old plot. In such cases, the location notes must be changed. Usually it is simplest to just record the azimuth and distance of the change. But if the starting point is within sight of the plot center, it is best to shoot a new azimuth (adding or subtracting 180°) and change the chainage to the new location. The latter can be done by adjusting the original chainage or by chaining back to the starting point.

4.61 Moving from Incorrect Location

Occasionally, because of inaccurate angle or distance measurements, or distortion on the photograph, the location reached is obviously incorrect when checked against the photo. In such a case a new plot is moved to the pin-pricked location shown on the photo, and the azimuth and distance of this move is recorded. An old plot (plot class 1), however, is taken at the old location even if the location does not check with the photo precisely. This is true so long as other factors listed below do not require moving the plot (plot class 2).

4.62 Moving Within Land Use and Sampling for Edge Effect

Each forest and nonforest plot will be taken completely within the land use class in which the plot center falls.

It is important, however, that we do not move forest plots so far within the forest stand that we avoid sampling the conditions in the line or strip of trees adjacent to the nonforest land. The following rules should be followed:

- a. New forest plots falling less than 120 links from a nonforest land use will be moved away from the nonforest up to a maximum of 120 links. The amount of this inward move, if any, depends upon the average size of the trees that dominate the border strip adjacent to the plot. This area of forest border strip is one chain long and 50 links deep. The average tree size in this strip (determined by observation) is based upon the trees that would dominate ten point samples if they were evenly distributed along the center of the border strip.

After this average tree size is determined, move the plot inward (at 90° to border) a distance equal to the plot radius indicated on the tape (BA 10) for that size of tree. If the distance from the edge already exceeds the required distance, leave the plot where it is.

- b. Old forest plots will be moved inward following the same rules as for new plots (a, above).

All plots that were moved inward to get away from a nonforest land use in the previous survey should be reexamined (notes on old photo) for the possibility of an outward shift (toward the

- c. New forest plots with existing--if the new plot center falls less than 79.8 links from some other land use, the plot center should be shifted a maximum of 79.7 links to get the entire 1/5-acre plot within the forest condition.

If the final location of plot center is less than 120 links from nonforest land, move the point sample inward so that its center is 120 links from the edge. In such cases, make a note on the plot sheet giving the distance and direction of the point sample center point from plot center.

In narrow strips of forest land, 120 to 158 feet wide, neither the plot nor the point sample should be shifted past the center of the strip.

4.63 Moving Completely Within Ownership Class

A forest plot falling near the boundary between two different classes of forest land ownership is shifted until the plot center is 120 links inside the ownership in which it fell. The shift is made in the direction perpendicular to the boundary. This applies to such cases as adjoining farm and national forest ownerships, but not to different properties within the same ownership class (sec. 6.61, c.). Do not shift for differences in ownership size within ownership class.

4.64 Shifting from Mixed Stand Conditions

Forest plots are shifted if a 120-link radius reaches more than one stand size or forest type one acre in size and at least 120 feet wide. The move is perpendicular to the edge of the condition and sufficient to get 120 links within the stand size or type in which plot center fell. A plot is not shifted into or away from a stand size or type under one acre in size or less than 120 feet wide.

4.65 Priority of Plot Shifts

Occasionally a crew chains to a new plot or relocates an old plot and finds that it lies on the boundary of 2 or more of the above conditions requiring shifts. In some cases a shift completely within one condition found at plot center would move it out of another. Because of this, an order of priority in determining plot shifts is necessary. Remember that a condition (except a road or railroad) is not considered distinct unless it is at least 1 acre in size and 120 feet wide.

The following order of importance should be given plot shifts:

1. Always first move a new plot to the correct location as indicated on the photo before other shifts are considered. Such a move should involve whatever distance is necessary to put the plot in the correct location.
2. The next consideration is to move completely within the land use in which plot center falls. If plot center is in a narrow strip of nonforest, say a 50-foot strip of pasture lying between cropland and forest, it should be moved away from the forest rather than into it. The separation of forest and nonforest is of more importance than separation of nonforest land uses. Shifts of plots in nonforest land uses should not exceed the radius of a 1/5-acre circular plot which is 79.8 links. Shifts of plots in forest land should not exceed 120 links.
3. The following order of priority should be given other shifts of plots located correctly according to the photo and completely within forest land:
 - a. Ownership class
 - b. Stand size
 - c. Forest type

All the above requirements should be met in one shift if possible, but do not move out of the ownership class that exists at plot center to get completely within one stand size or type. Do not move out of stand size to get completely within one type.

4.66 Selection of Substitute Plots

There are a few instances (only a few per state) in which it is necessary to select a substitute for a forest plot. This is done in the following cases:

- a. The owner positively objects to having a plot established on his property.
- b. The plot was selected by error on public land withdrawn from commercial timber production. A plot falling in a national park would be an example of this.

In such cases, the substitute plot is the forest grid plot closest to the original plot, but off that property. Where two forest grid plots are equally close, flip a coin to decide which should be used as the substitute. The substitute plot should be shown on the photo, the ownership information should be obtained and recorded, and a note about the substitution should be made on the plot sheet. These substitutions should be made by the field crew.

The field supervisor should be notified about any plot that is inaccessible (cannot be gotten in one crew-day). The field supervisor will decide upon the action to be taken in such cases.

4.7 Establishing Forest Sample Plots

Each forest sample plot is established with a degree of permanence that will provide precise relocation for at least the next 8 years. The plot location notes should enable relocation of the close vicinity of plot center. Then the following should permit exact relocation:

4.71 Plot Center Pin

A galvanized wire pin about 18 inches long is inserted in the ground at plot center leaving about 6 inches above ground in the form of a compressed loop. On old plots (plot class 1) the old center pins should be replaced with new pins if the old pins are damaged by rust or corrosion.

4.72 Witness Tree

One tree on each plot is chosen as a witness tree. Where possible, it should meet the following specifications:

- a. It should be a tree not likely to die or be cut in the next eight years.
- b. It should be close to plot center.
- c. It should be a species that can be located easily in the stand.
- d. It should be at least 2 inches in diameter.

A 4-inch dogwood 10 links from plot center would be an ideal witness tree in a pine stand, but a similar cedar would be better in a hardwood stand. The following data are recorded for the witness tree:

- a. Species
- b. D.b.h. to 1/10 inch
- c. Azimuth from plot center
- d. Distance along the ground surface from plot center in links

Two slanting scribe marks just through the cambium and about 4 inches apart are made well above d.b.h. on the plot-center side of the witness tree.

On plots that may be difficult to relocate it is worthwhile to mark a second witness tree and tag it at the stump. If this tree is picked after the tally is complete, the only record needed might be such as "Tree #3 is W #2."

4.73 Plot Tags

Two plain aluminum tags are nailed to the witness tree facing plot center. One tag 3 to 4 inches long and 1-1/2 inches wide is attached above the scribe marks with an aluminum nail. The nail should be driven through the center of the tag and into the tree just far enough to hold the tag securely. Another aluminum tag about 5 inches long and 1/2-inch wide is attached to the base of the tree. It should be attached with an aluminum nail driven through the end of the tag.

4.74 Plot Slope

The system of uniform slope correction is used on all Forest Survey plots. In this method, the plot radius is increased as the general slope of the plot increases in order to keep the horizontal area uniform and still maintain a round plot on the land surface. The change in radius is not continuous, but made in slope classes. Classes of 10 feet in rise or decline per chain of horizontal distance are used. Thus, 0-5 is plot slope 0, 6-15 is plot slope 10, 16-25 is plot slope 20, etc. The plot slope is determined in the following manner:

- a. Pick the steepest 1-chain diameter across plot center (not always the two steepest radii).
- b. Measure the slope along this steepest diameter each way from plot center. Ordinarily one reading is plus and the other minus, but a plot on a ridge might have two minus readings and both might be plus for a plot in a drain.

- c. Disregarding plus and minus signs, add the two readings together and divide by 2 to get average plot slope. Round the average slope to the 10-foot slope class that includes it and enter it on the plot sheet as plot slope.

The plot slope class is recorded on the plot sheet. The recorded plot slope permanently fixes the plot radii that can be used in this and subsequent plot measurements.

5 PROCEDURE ON NONFOREST PLOTS

One-fifth-acre circular plots are used to sample nonforest land uses. If the plot overlaps two land uses, it is moved completely (79.8 links) within the land use in which plot center fell.

5.1 Nonforest Plots Reverting to Forest

Some plots drawn for the nonforest field sample will fall in areas that were nonforest but are now reverting or have reverted to forest. If there is some doubt whether or not the acre qualifies as forest land (sec. 2.41), a count of the stocking on the acre will be made. All well-spaced trees, regardless of tree class, should be included in the count. Ten percent stocking is required in reverting areas to qualify as forest. A table on the code sheet (Appendix) is furnished to simplify computation of stocking percent.

In cases where the area in question is a narrow strip not much wider than the 120-foot minimum, a long acre or an irregularly-shaped acre is used.

Some plots will fall in the border zone between an old field or other nonforest area and forest land where a scattering of tree seedlings or sprouts have become established. The question here is not whether or not an acre of the field has reverted to forest, but whether or not the boundary of the forest land has moved far enough into the field to include the point pin-pricked on the photo. The way to decide this is to count the stocking along the border in the condition similar to that at the pin-pricked point. This zone should follow the border even if it curves. Where the stocking is uniform, an area of less than an acre may be used to check these border zones.

5.2 Information Recorded on Nonforest Plots

The amount of information recorded on plots found on the ground to be nonforest depends upon whether or not cutting, clearing, flooding, etc., has occurred during the specified cutting period (sec. 6.14).

5.21 Nonforest Plots Without Cutting

Most plots with nonforest ground land use will be in this group, drawn as nonforest plots and having no cutting (not even shade trees, fence-row trees, etc.). The following information is recorded for these plots:

- a. Identification codes including survey unit, county, plot number, photo number, and photo grid number.
- b. Plot class (sec. 3.21).
- c. P.I. land use (sec. 6.61, b).
- d. Ground land use (sec. 6.61, b).
- e. Cause of land use change (sec. 2.42).
- f. Initials of crew members with those of the crew chief listed first.

- g. Date of the field observations.
- h. Wood naval stores availability class and number of stumps in survey units designated for collection of this information.

5.22 Nonforest Plots With Cutting

This group includes all plots found on the ground to be nonforest but which had cutting, clearing, flooding, etc., during the cutting period. This includes trees removed from commercial forest by change to any nonforest land use even though the trees were not cut (as in newly developed urban areas). It also includes nonforest plots with cutting of shade trees, trees in fence-rows, etc.

All the information listed above (sec. 5.2) is required for these plots. In addition, the following data are required:

- a. Tally.--Record the tally of timber cut trees.
- b. Ownership.--For all plots that were forest land at the time of cutting, record the ownership class and ownership size that applied at that time.
- c. Site class.--Estimate and record site class.
- d. Cutting history.--Record for all plots in this group. Code 0 (no cutting) is not an acceptable code.
- e. Previous size and Previous type.--These are to be recorded for all plots that were forest at the time of cutting, clearing, etc. Record the stand size (sec. 6.61, d) and forest type (sec. 6.61, e) that existed before the cutting took place. Record x's in these spaces for nonforest cutting (shade trees, fence-row trees, etc.).

6 CRUISING PROCEDURE ON FOREST PLOTS

The forest field plots sample the area classified by the photo interpreter as forest land, excluding only reserved forest land in public parks, national monuments, etc.

The field supervisor may decide that a few of the plots are on forest land that is obviously unproductive after observation from the air, or based on other dependable information. In such cases, the plots are not visited on the ground; but plot sheets should be submitted with the plot description completed as fully as possible, including the best available idea of stand size and forest type.

This segment of the field instructions covers the work on a forest plot after its location has been established with a plot center pin and witness tree (sec. 4.7). The following procedures apply to all forest plots visited on the ground, both on commercial forest and noncommercial forest land.

6.1 Timber Cut

Timber cut includes all trees above a specified size that have been killed by actions of man--like cutting, poisoning, girdling, flooding in reservoirs, etc., within a certain period (see Cutting Period, sec. 6.14). Mortality (sec. 6.22), on the other hand, includes trees killed or dying from natural causes.

6.11 Tree Size and Plot Size for Timber Cut (and Mortality)

The size of a tree tallied for timber cut (and mortality) depends upon (1) its location, (2) the plot class, and (3) if it was in the previous survey tally, its size at that time.

- a. On class 1 and 2 plots (sec. 4.1) all timber cut trees (and mortality trees) that were in the 4-inch d.b.h. class or larger in the previous tally are included. This is the 4-inch tally on the 1/100-acre plot, softwoods in the 6-inch and 8-inch tallies, and hardwoods in the 6-inch, 8-inch, and 10-inch tallies on the 1/50-acre plot, and larger tallies on the 1/5-acre plot.

Included also are ingrowth trees cut on the 1/100-acre plot in the past three years. These are the trees too small for the 4-inch tally in the previous survey, which grew to at least 4.0 inches d.b.h. or at least 5.0 inches d.o.b. at a stump height of 2 feet or less and were cut, poisoned, etc., in the past three years.

- b. On class 3 and 4 plots (sec. 4.1) there is no old tally. On these plots all timber cut (and mortality) trees 4.0 inches d.b.h. or larger or 5.0 inches d.o.b. at a stump height of 2 feet or less are included on the 1/100 acre; and timber cut trees 8.0 inches (either d.b.h. or stump d.o.b.) or larger are tallied on the 1/5-acre plot.
- c. On plot class 5 (sec. 4.1) the tally of cut trees in the 4-inch class or larger is usually listed in the office. Where a field check is requested, the field crew lists those trees as timber cut that were in the 4-inch tally or larger in the previous survey and are no longer live trees growing on forest land.

For all class 5 plots, ingrowth cut will be added in the office on the basis of averages.

6.12 Location of Timber Cut Plots

The location of the common center of the timber cut (and mortality) plots is as follows:

- a. For a class 1 or 2 plot, where the old plot is accurately relocated, the timber cut plot center is the same as that of the old plot. No timber cut plot is taken at the variable plot (sec. 6.31) portion of a class 2 plot which, by definition, has been shifted.
- b. For a class 3 or 4 plot, the timber cut plot is taken at the location of the variable plot.
- c. For class 5 plots, the center of the timber cut plot is the center of the old plot.

6.13 Slope Correction on Timber Cut Plots

The uniform slope correction described in section 4.74 is used in checking the timber cut (and mortality) plot radii to borderline trees or stumps. There are a few exceptions, however, that must be taken into account in reconstructing the old tallies taken in the following areas:

- a. Plot radius was corrected individually for the slope from plot center to each tree in the second survey of North Carolina Unit 1, Virginia Unit 1, and the 14 TRR sample counties in Units 2, 3, and 4 of North Carolina. These 14 counties are identified in the county list for North Carolina (Appendix).

- b. In the other counties (not TRR) of North Carolina Units 2, 3, and 4, and all of Virginia except Unit 1, the uniform slope correction was used in the second survey; but 20-foot slope classes were used instead of the 10-foot classes adopted in more recent surveys. Slopes 0-9 were classed as 0, slopes 10-29 were classed as 20, 30-49 as 40, etc. These slopes were coded in recording on the plot sheet as slope 0, slope 2, slope 4, etc.

6.14 Cutting Period

The cutting period is the time since the last survey for trees cut, poisoned, bulldozed, etc., that were in the old 4-inch or larger tally on class 1 and 2 plots.

For the old tally on class 5 plots, it is the period between the date of measurement in the previous survey and the date of the new photography used in this survey.

For all other trees the cutting period is 3 years extending back from the date that the plot is examined.

6.15 Criteria for Determining Date of Cutting

Callus growth on logging scars is by far the best criterion for estimating date of cutting. By carefully chopping into the callus edge, the number of annual rings or portions of rings which have formed since the scar was made can be counted. Care must be used to select a scar actually caused by the logging operation in question since more than one cutting may have been made. Scars along old roads and trails should be avoided if possible.

The time of year that cutting took place usually can be determined by careful examination of the last ring on several stumps. On hardwoods, the age of sprouts is a fairly good indicator, although not always reliable. The appearance and condition of the stump and the remaining top portion may be used where callus or sprout ring counts cannot be made. In doubtful cases, an attempt to contact the landowner, tenant, or a local person able to give information on time of cutting should be made.

The following criteria were based on a study made in the coastal plain of Georgia. Stumps may deteriorate at a somewhat slower rate farther north and at higher elevations. Where condition of stumps is used to establish age of cutting, several stumps should be examined. There is considerable variation in rate of deterioration, especially between species in hardwoods. An occasional pine stump remains alive for a year or so because of root grafts.

Guides for Estimating Time of Cutting

<u>Pines</u>				
	<u>1st year</u>	<u>2nd year</u>	<u>3rd year</u>	<u>4th year</u>
Depth of side rot in stump	0.5"	1.5" - 2.5"	4" - 5"	6"
Condition of stump top	Solid	Fairly solid. Sections can be knocked in	Still intact to slightly caved in	Usually warping and caving in
Rotten material in stump under cap	None to punky	Punky to soft rot in streaks	Crumbly to humus-like	More humus-like material red or black

Guides for Estimating Time of Cutting (Cont.)

Pines

	<u>1st year</u>	<u>2nd year</u>	<u>3rd year</u>	<u>4th year</u>
Bark	Tight to loose	Loose (may be loose to very loose in loblolly)	Loose (Some very loose)	Very loose and falling away
Needles	All remaining	Some on upper side of twigs, most all on under side	None to few	None
Tree tops	Intact. Limbs solid	Mostly intact. Some limbs punky	2" limbs broken. Larger limbs punky to rotten	Some large limbs remaining
Callus	0-1 year	1-2 years	2-3 years	3 years or more
Sprouts	1 year or less	2 years or less	3 years or less	4 years or less

Hardwoods

- a. Use callus formations or age of sprouts.
- b. Rot and condition of tops are usually one year more advanced than pine except for stumps that stayed alive after cutting.
- c. Stumps are usually falling apart after 3 years except for stumps that stayed alive after cutting.

Cypress and Cedar

Use callus formations or age of sprouts on other trees damaged or cut in the same logging operation.

6.16 Data Recorded for Each Cut (or Mortality) Tree

Information is recorded on the tally sheet (Form 3) for each timber cut (or mortality) tree that was in the 4-inch class or larger of the old tally on class 1, 2, and 5 plots. The same is done in the ingrowth cut (and mortality) on class 1 and 2 plots and the complete tally on class 3 and 4 plots, except where one or more of these stumps has been removed and cannot be measured. In this case do not make the ingrowth or new plot cut (or mortality) tally, but enter the appropriate cutting history code (sec. 6.61, i) which indicates this fact.

- a. Reconstruction of the old tally must be performed on all class 1 and 2 plots. Each tree in the old tally that was alive and in the 4-inch d.b.h. class or larger is identified on the old tally sheet as to its present status. Trees that are still alive are given a check mark (✓), a C is marked beside the timber cut trees, and an M beside those that died of natural causes.

In Unit 1, N. C., where the sample trees were listed separate from the tally in the second survey, the status of the individual sample trees should be indicated also. This is necessary for use in developing average lengths for cut and mortality trees.

- b. Old d.b.h. class at the time of the previous survey is listed for each timber cut (and mortality) tree or stump that was in the old tally of trees in the 4-inch class or larger on class 1, 2, and 5 plots. It is important that this be recorded even though "d.b.h. now" (below) is measured and recorded, since it will be used to indicate the period of years and size of plot that apply.
- c. Species codes used in the tally of live trees are used also in the tally of timber cut (and mortality). In reconstructing the old tally, it should be remembered that some of the species codes have been changed since the second surveys of North Carolina and Virginia. These species with their old species codes are listed in the coding summary (Appendix).
- d. Timber cut/mortality identification codes are needed to separate timber cut trees and stumps from mortality, since they are tallied together. One of the following codes is recorded for each stump or tree:
 - Code 1 - A live tree cut, poisoned, girdled, etc.
 - Code 2 - A mortality tree cut for use after the tree died.
 - Code 3 - A mortality tree not used.
- e. Cause of death is recorded as 00 for each timber cut tree (cut/mort., code 1). Cause of death for mortality trees will be covered fully later (sec. 6.23).
- f. Tree class (sec. 2.35) which applied immediately before cutting, poisoning, girdling, damaging in logging, etc., is recorded. On class 1 and 2 plots the tree quality shown on the old tally sheet will aid in assigning tree class to cut trees.
- g. Present d.b.h. (DBH NOW) should be measured for timber cut (and mortality) trees (old tally, ingrowth, or tally on new plots) if it is possible to do so. This d.b.h. is recorded to tenths of inches.
- h. Stump diameter outside bark (STUMP DOB) is measured only on ingrowth trees and trees on new plots (plot class 3 or 4) where "DBH NOW" cannot be measured. This applies also to "HEIGHT OF DOB" and "STUMP CLASS" which follow (i and j).

Stump diameter is measured outside bark (DOB) at any point 2 feet or less above ground on trees not swell-butt, or at any point at or below bottleneck on swell-butt trees. Diameter is measured to the nearest one-tenth inch with a diameter tape. In cases where stump diameters are abnormally large or small because of interior rot, cat faces, turpentining, splitting in felling, removal of bark, etc., the normal diameter should be estimated.

- i. Height of stump d.o.b. measurement is recorded wherever stump d.o.b. is listed. Stumps are measured at any convenient point up to 2.0 feet. Therefore, it is necessary to include height of this measurement in the equation that converts stump d.o.b. to d.b.h. for volume computation.

For stumps of trees that are ^{not} normally swell-butt, ^{but have a butt swell from} height of ^{defect,} the point of stump diameter measurement is measured from the ground. The height to that point is recorded in feet to tenths

of feet. Diameter should be measured as high on the stump as possible to a maximum height of 2 feet.

For stumps of trees that are naturally swell-buttred, height of the point of stump diameter measurement is recorded in feet (to tenths) below bottleneck. These are the trees whose diameters would be measured 1-1/2 feet above bottleneck (sec. 2.21). Obviously, the distance below bottleneck must be estimated for stumps cut below that point. Butt swell is related to depth of water that periodically stands in swamps, so heights of bottlenecks are usually rather uniform by tree size on a given plot. The height of butt swell on uncut trees can be used as an aid in estimating the height of bottleneck on stumps cut below that point.

- j. Stump class must be recorded for each tree with stump d.o.b. to indicate the lower-stem form which applies, as follows:

Code 1 - Stumps of all except swell-buttred trees.

Code 2 - Stumps of swell-buttred trees.

- k. Period of years over which cutting (or natural mortality) might have occurred is recorded to tenths of years (sec. 6.16 and 6.22). This is recorded in the office.
- l. Number of trees per acre represented by the timber cut (or mortality) tree tallied is recorded in the office. This is the denominator of the fractional part of an acre used as the sample plot, 100, 50, or 5.

6.2 Mortality

Mortality includes all trees above a specified size that have been killed or have died as result of natural causes such as disease, insects, lightning, windstorm, flooding in beaver dams, etc., within a certain period (sec. 6.22).

6.21 Timber Cut Instructions that Apply to Mortality

Most of the instructions given for timber cut in section 6.1 apply also to mortality. These instructions that are common to both with their references are as follows:

- a. Tree size and plot size--sec. 6.11
- b. Location of the sample plot--sec. 6.12
- c. Slope correction on the plot--sec. 6.13
- d. The following recorded data for each tree are the same for cut and mortality:
 - (1) Old d.b.h. class--sec. 6.16,b.
 - (2) Species code--sec. 6.16,c.
 - (3) Timber cut/mort. identification--sec. 6.16,d.
 - (4) Tree class--sec. 6.16,f.
 - (5) Stump diameter outside bark--sec. 6.16,h.
 - (6) Height of stump d.o.b.--sec. 6.16,i.
 - (7) Stump class--sec. 6.16,j.
 - (8) Period of years--sec. 6.16,k.
 - (9) Number of trees--sec. 6.16,l.

6.22 Mortality Period

The mortality period is the time since the last survey for trees in the old tally of the 4-inch class or larger on class 1 and 2 plots.

For the old tally on class 5 plots, it is the period between the date of measurement in the previous survey and the date of the new photography used in this survey.

For all other trees the mortality period is 12 months extending back from the date that the plot is examined.

6.23 Cause of Death

A code indicating cause of death will be listed for each mortality tree. These are the same codes as the 2-digit cause of damage codes (sec. 2.33 and 2.34) for live trees, except that a few additional codes are used.

The first digit of the code applies to tree diseases only, while the second digit applies to insects, other physical causes, and unknown causes. The possible causes of death that follow are listed in two groups. The first group is for tree diseases, assuming no other cause present. The second group is for insects and other physical causes, assuming no disease present. Obviously, a large number of combinations of these two groups might occur.

Portion of code indicating disease

First digit of code	Cause of death	Trees considered
0-	No disease	Any tree ^{1/}
1-	Littleleaf disease	Shortleaf or loblolly pine
2-	Fusiform (on main stem)	Pines
3-	Oak wilt	Oaks
4-	Other major disease	Any tree ^{2/}
5-	Littleleaf and fusiform	Shortleaf and loblolly pine
6-	Littleleaf and other major disease	Shortleaf and loblolly pine
7-	Fusiform and other major disease	Pines
8-	Oak wilt and other major disease	Oaks

Portion of code indicating other causes

Second digit of code	Cause of death	Trees considered
-0	No other cause	Any tree ^{1/}
-1	Southern pine beetle, with or without other insects	Pines
-2	Ips alone or with unlisted insect	Pines
-3	Black turpentine beetle alone or with unlisted insect	Pines
-4	Ips and black turpentine beetle with or without unlisted insect	Pines
-5	Unlisted insect	Any tree
-6	Fire (without pine bark beetles)	Any tree
-7	Windthrow or lightning	Any tree
-8	Other known physical cause	Any tree
-9	Unknown cause	Any tree

1/ No mortality tree should have cause of death code 00, but timber cut trees (cut/mort. code 1) should all receive cause of death code 00.

2/ Cause of death code 40 for other major disease should not be given species that have no known major diseases. The common heartrots of hardwoods should not be considered as major diseases.

6.3 The Tally of Live Trees

The procedures to be followed in tallying live trees 1.0 inch d.b.h. or larger are included in these sections. Instructions on collection of the detailed tree data, such as cull and growth, are covered in section 6.4.

6.31 The Variable Plot

The tally of live trees 1.0 inch d.b.h. or larger is made on a variable plot almost equivalent to a "point sample" based on a 3.03-diopter prism. The difference is that change in plot radius is not continuous with change in tree diameter, but varies only by 2-inch diameter class. The 2-inch trees (1.00"--but less than 3.00") are tallied on the size of plot fitting the 4-inch class so as to avoid extremely large expansion factors. All other plot radii in links are computed as $4.1667 \times \text{d.b.h.}$ or the midpoint of the 2-inch diameter class. For example, the plot radius for the 20-inch class, including trees 19.00" but less than 21.00" d.b.h. would be 4.1667×20 or 83.33 links. Plot radii for diameters through 50 inches with slope corrections (see plot slope in sec. 4.74) are listed in the coding summary (Appendix). Radii for larger diameter classes can be computed using the factor, $4.1667 \times \text{d.b.h. class}$, and the uniform slope correction factors listed in the coding summary.

6.32 Use of the Plot-Measuring Tape

A 1-chain tape ordinarily is used in checking plot radii for the tree tally, but where the plot contains a heavy stand of trees larger than 24 inches d.b.h., a 2-chain tape would be more suitable.

Variable plot radii and slope corrections are painted on the 1-chain tape as they apply to the midpoint of the diameter class. The minimum diameter included in each radius (9.0, 11.0, etc.) is painted just in front of the radius of each horizontal plot, and all trees that size or larger are included in the tally. These paint marks and numbers alternate in color (red and yellow) by diameter class to prevent confusion caused by some of the slope corrections for steep slopes overlapping the radius for the next larger diameter class. It is necessary to refer to the coding summary for trees over 24 inches d.b.h. that fall more than one chain from plot center.

The zero-end of the 1-chain tape should be pinned down at plot center or be tied to a stake at that point. The chain is first pulled out on the zero azimuth or toward the first tree or stump to be checked to the right of that azimuth. On new plots (class 3 and 4 plots) it is most efficient to tally live trees, timber cut, and mortality in one clockwise sweep around the plot; but on old plots (class 1 and 2 plots), the live-tree tally should be a separate operation. Each time the tape is moved to measure a new radius, it should be picked up at plot center to avoid kinking or breaking the tape. If the 1-chain tape is used, it may be necessary to extend the tape occasionally to check the radius to a tree over 24 inches d.b.h. falling outside a 1-chain radius.

6.33 Tree Azimuth

This is the azimuth of the stump of the tree as measured from plot center. The tally man should measure the azimuth to the nearest whole degree and record it in the appropriate space on the tally sheet (Form 3).

6.34 Tree Distance

This is the distance in links from plot center to the center of the tree's stump measured along the surface of the ground. The measurer usually obtains this figure. However, where the tally man is not rushed, he can speed up the work by measuring distances to trees just ahead of the measurer and pointing out the trees to be tallied.

6.35 Tree Number

Numbers already printed on the tally form number the trees consecutively as they are tallied. The numbering need not be changed in a case where a tree is later removed from the tally.

6.36 Tree D.b.h.

D.b.h. (sec. 2.21) is determined by the measurer with a diameter tape and reported to tenths of inches.

6.37 Tree Species

Species is determined by the measurer and called to the tally man by common species name (species list, Appendix).

6.38 Crown Class

Tree crown class (sec. 2.32) is determined by the measurer for each live tree tallied.

6.39 General Order of Measuring, Calling, and Recording the Tally

The measurer should use about the following procedure in measuring and calling out the above items for a tree:

- a. He approaches the tree pulling the chain out over his arm. As he does this he looks the tree over to make sure it is alive, identify the species, and determine the crown class.
- b. When he reaches the tree he measures the diameter.
- c. He checks the chain to see if the tree is to be tallied. If so, he reads the distance to the tree.
- d. If he is not yet certain of the tree species or crown class, he should walk around the tree and look it over carefully.
- e. He then calls out the tally, such as "Seventy links, eighteen point one, loblolly pine, dominant," and moves on to the next tree.
- f. He keeps the tally in his mind, however, until he hears the crew chief call it back to him as it is being recorded. If the tally man fails to call it back, the measurer reminds him so as to make sure the tally was made and recorded correctly.

While the measurer has been doing the above, the tally man has shot the tree azimuth and may have assisted the measurer by checking on the next tree to be tallied, or helped him in determining the tree species, etc. The tally man should keep his attention on the above, and never divert it by going ahead with computing cull, grading, etc.; nor should he help the measurer so much that he neglects the job of tallying.

6.4 Detailed Data on Live Trees

After the timber cut and mortality tallies (sec. 6.1 and 6.2) and the variable plot tally (sec. 6.3) have been completed, each tree on the variable plot is relocated for the following measurements and observations:

6.41 Damaging Agent

The crew chief examines each tree for evidence of disease and insect damage (sec. 2.33 and 2.34). A 2-digit code is used to report the presence or absence of damage, with the first digit for disease and the second for insects.

Section 6.23 describes fully the procedure used in recording cause of death for mortality trees. The same procedure and the same codes are used for damaged live trees, except that codes 06, 07, 08, and 09 for other physical causes and unknown causes do not apply to live trees.

6.42 Radial Growth

The measurer bores each live tally tree 4.0 inches d.b.h. or larger to determine radial growth during the last 5 complete growing seasons. Radial growth is measured at the point of diameter measurement (sec. 2.21). Except on steep slopes, the boring should be on the side facing plot center. Where slopes are steep, bore on the uphill side. A tree should not be bored if the tree is so scarred or deformed at the point of d.b.h. measurement that it is not possible to get a true evaluation of the tree's rate of growth. Ordinarily a tree may be bored for growth even though d.b.h. must be estimated because of limbs, scars, etc.

Measurement is made in units of twentieths of inches and is recorded without a decimal point. A scale is provided for making direct readings. Thus, a tree with 5-year radial growth of 1.15 inches would cover 23 spaces on the scale and would be called out and recorded as 23. This system simplifies the office work since we want average annual growth per year during the 5-year period. You can see that $1.15" \div 5 \text{ years} = .23"$; also, $23 (.05 \div 5 \text{ years}) = .23"$; so the value recorded is the average annual growth in hundredths of an inch.

6.43 Log Grades

The butt log of each sawtimber-sized growing stock tree is graded. The saw-log portion should be segmented as a timber cutter does to minimize loss due to cull and to obtain logs of good quality. The log to be graded is the butt log. If the tree has a jump butt at the stump, it is the first merchantable log above that cull section.

No rigid rule for length of the butt log is used, except that in trees with less than 16 feet of merchantable length in the saw-log portion, the entire merchantable length should be graded as one log. The length of the log to be graded depends upon the total length of the saw-log portion, sweep, crook, and surface defects. Whenever possible, lengths of 12 to 16 feet should be used.

Data obtained on special log grade studies will be used in the office to determine the breakdown of total board-foot volume by log grade where the grade of the butt log has been determined for each sawtimber tree. A considerable backlog of log grade data for all logs in the tree (using variable-length logs) is now on hand; and additional special studies will be made as needed.

- a. Softwood log grades, the Interim Log Grades for Southern Pines, will be used to grade all softwoods (including cypress and Atlantic white-cedar).

The following terms should be fully understood and kept in mind in grading softwoods:

Overgrown knot, any branch or stub partially or completely buried beneath the log surface. Do not include overgrown adventitious knots.

Sound knot, any branch, stub, or socket not overgrown which contains neither advance decay extending to the log heart nor any hole over 1/4 inch in diameter penetrating more than 2 inches. Do not include adventitious knots, twigs, or limbs.

Unsound knot, any branch, stub, or socket not overgrown which contains advance decay extending to the log heart or a hole over 1/4 inch in diameter penetrating more than 2 inches.

D, diameter of the small end of the log inside bark to the nearest inch.

K, number of overgrown knots, plus the sum of the diameters of sound knots, plus twice the sum of the diameters of the unsound knots. Knots 1 inch or under (except adventitious knots) are counted as 1 inch.

Bad knot, any knot over 1/6 of D, or an unsound knot.

The first step is to determine D, the scaling diameter of the log. Then examine the entire log surface to determine K. Using D and K, arrive at the highest possible tentative grade as follows:

Grade 1 - D is 17" or more, and D is as large as 5 times K.

Grade 2 - Does not qualify for Grade 1, but D is 10" or more, and D is as large as 2 times K.

Grade 3 - D is under 10", or D is less than 2 times K.

Grade 4 - Reached only in the next step.

The next step is to degrade the log for sweep or bad knots as follows:

(1) Reduce any tentative grade by one grade if D is not more than 3 times any sweep the log has of 3 inches or more.

(2) Then reduce any Grade 3 log to Grade 4 if all bad knots cannot be contained in a 90-degree radial sector (one face) extending 1/4 of the log length.

- b. Hardwood logs are graded with the Hardwood Log Grades for Standard Lumber with a grade added for tie and timber logs. The butt log should be examined first to see if it meets the requirements of a lumber log (Grade 1, 2, or 3). If it fails to make a lumber log, it is considered for a tie and timber log (Grade 4). Of course, to qualify as a growing stock tree of sawtimber size the tree must have a butt log (sometimes above a jump butt) of at least Grade 4.

The factory lumber grades, the top three grades, evaluate the log for production of factory lumber in which yield of large clear pieces of lumber is the important thing. Any surface irregularity or abnormality that reduces the number or size of clear cuttings in a board is considered a log defect. Stubs, branches, bumps, and holes are obvious defects. Overgrown knots, grub holes, ant damage, and various surface wounds, while less obvious, are also serious defects.

In applying the factory lumber log grades (Grades 1, 2, and 3), the surface of the log is visualized as being divided into four equal sides, or faces, and each face is inspected much as if it were a board. The faces should be oriented to give the largest possible number of good faces. Each defect should be confined to a single face wherever possible. The grade of the log is the minimum grade of the three best faces. Therefore, in practice, the grader should select the three best faces, determine which of the three is poorest, and grade that face only. The chart in the coding summary (Appendix) furnishes limits of the different factors to be considered in arriving at the log grades for various diameters and lengths of logs.

Each estimator should study Agricultural Handbook No. 4, "Log defects in southern hardwoods" and Forest Products Laboratory Bulletin No. D1737-A, "Hardwood log grades for standard lumber and how to apply them."

The tie and timber grade is the lowest limit for merchantability for a hardwood log that will not qualify for Grade 3. Here, straightness, soundness, and effect of defects on the strength of the tie or timber are the important factors. The log must be sound internally (cannot have a rotten center), and no single knot or group of knots within a 6-inch section of the log can exceed $\frac{1}{3}$ the log diameter at that point. Rotten defects or holes can be present on the surface of the log, but they must not extend more than 3 inches into the potential tie or timber. Sweep departure in inches minus 1 inch per 8 feet in the affected portion cannot exceed $\frac{1}{2}$ the scaling diameter of the affected portion, and departure of crook cannot exceed $\frac{1}{2}$ the scaling diameter of the affected portion. Total cull volume in the log cannot exceed 50 percent of the gross board-foot volume. A summary of the limits for the tie and timber grade is given in the coding summary.

6.44 Tree Class

Each tree 1.0 inch d.b.h. or larger is examined carefully by the crew chief to determine tree class (sec. 2.35). In some cases it is necessary to measure radial growth, grade the butt log, measure saw-log portion length, and estimate volume of cull before deciding upon tree class. A pine less than 5.0 inches d.b.h. given damage code 2-, 5-, or 7-, which include fusiform, should be given tree class 6 for rotten cull.

Tree class of seedlings and small saplings is based upon the species and the site upon which they occur (see the list of preferred species, Appendix).

Tree class of a tree of large sapling or poletimber-size is based upon the potential size and quality of the tree when it reaches 13" d.b.h. (or maturity, if it is not likely to reach 13" before maturity).

The merchantability requirements that follow must be met by a tree of sawtimber-size to qualify it as growing stock (tree class 1, 2, 3, and 4). The minimum merchantability requirements for a sawtimber tree are:

- a. It must contain at least one merchantable saw log. To be merchantable, a saw log must meet the following requirements:

- (1) Minimum saw-log length is 8 feet.
- (2) Grade of a hardwood log must meet the minimum requirements for either log grade Code 3 or Code 4 (see log grade chart in Appendix).
- (3) Top scaling diameter (inside bark) must be at least 6 inches for softwoods (actually 5.5" is permitted in a softwood 9.0" d.b.h.) and 8 inches for hardwoods.
- (4) Maximum sweep and crook differs for softwoods and hardwoods. Sweep (fig. 3,a) is measured in inches of departure of the center line of the portion of the log with sweep from a straight line joining the log's center at each end of the portion with sweep. Crook is usually more of an abrupt bend than is sweep, but a sweep affecting a section of 6 feet or less is usually handled as crook. Crook (fig. 3,b) is measured in inches maximum departure of the log center line from an extension of the center line of the straight portion of the log. The maximum departures are based on the following rules for softwoods and hardwoods:

Softwoods.--For sweep, departure in inches minus 1 inch per 8 feet of length in the affected portion cannot exceed $\frac{2}{3}$ of the scaling diameter of the affected portion. In softwoods the maximum allowable departure for crook is set at $\frac{2}{3}$ the scaling diameter regardless of the length of the affected portion.

Hardwoods.--For sweep, departure in inches minus 1 inch per 8 feet of length in the affected portion cannot exceed $\frac{1}{2}$ of the scaling diameter of the affected portion. Departure of crook cannot exceed $\frac{1}{2}$ the scaling diameter of the affected portion. These maximums are not permitted in the better log grades (table, Appendix).

Where sweep exceeds the maximum that is allowed, it may be necessary to consider that portion as 100 percent cull in board feet. Where crook is at either end of the log, it is usually possible to throw the excessive crook into a short cull section and consider the rest of the log sound. Of course, the remaining sound portion must be at least 3 feet long.

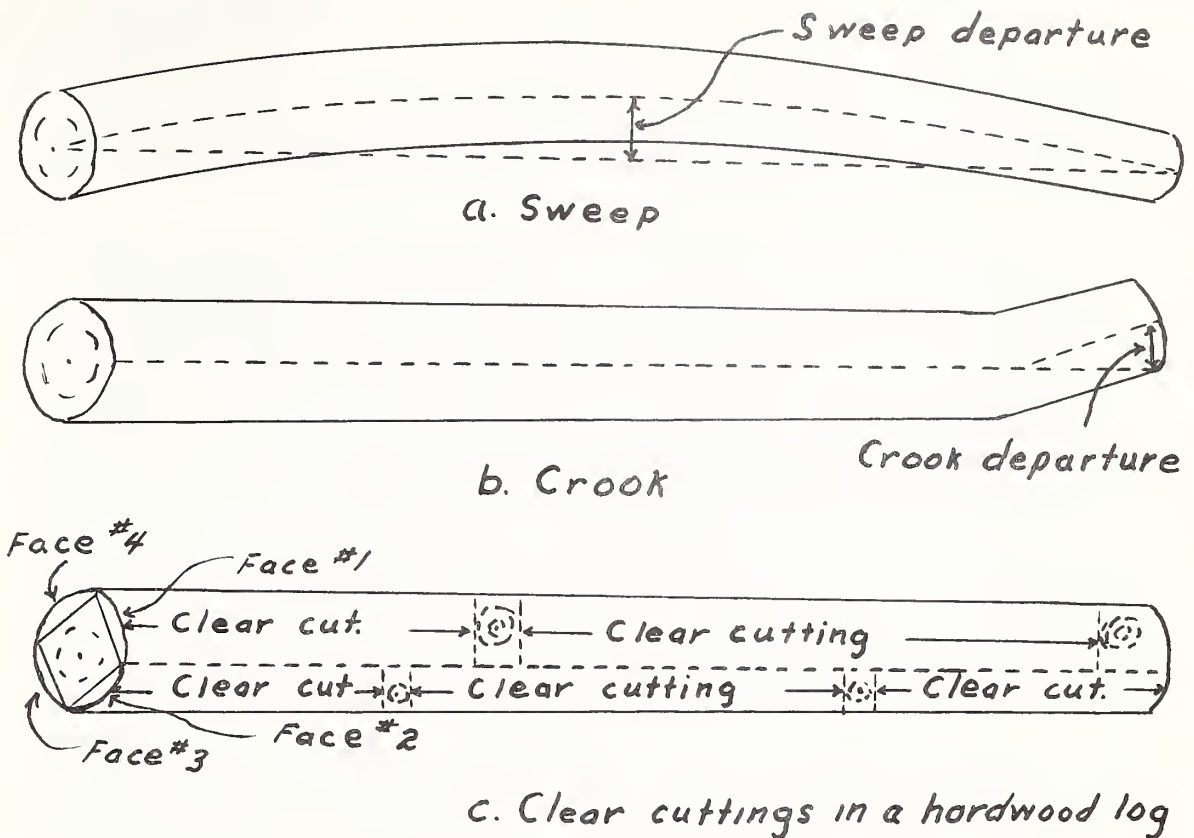


Figure 3.--Diagrams illustrating measurement of sweep and crook in all saw logs, and the arrangement of faces and measurement of clear cuttings in hardwood saw logs.

- (5) Maximum allowable size of limbs or knots differs by species group and, in the case of hardwoods, with log grade. Limb diameters are measured outside bark where they usually are trimmed from the bole in logging. Limb diameter is the sum of the individual diameters of limbs and knots within any 6-inch section of the bole. The maximum allowable diameters are:

Softwood logs except redcedar: Only "bad knots" as defined in the "Interim Log Grades for Southern Pines" (sec. 6.43,a) are considered. Smaller limbs and knots are ignored. Within a 6-inch section of the bole the sum of the diameters of the bad knots cannot exceed $\frac{2}{3}$ the stem diameter, unless they are all on one side of the stem (a continuous $\frac{1}{2}$ circumference). A merchantable log can contain one such whorl or group of bad knots if $\frac{1}{2}$ the circumference at that point is clear of bad knots; but two or more such points in the same log must be so arranged as to permit sawing at least $33\frac{1}{3}$ percent of the log volume into lumber that will be 8 feet or longer after trimming off such whorls or groups of bad knots.

Redcedar logs: No limit.

Hardwood factory lumber logs: No limit.

Hardwood tie and timber logs: Not more than $1/3$ of the stem diameter outside bark at that point.

(6) Maximum allowable cull varies with species group and, in the case of hardwoods, with log grade. In making estimates of board-foot cull volume, the saw-log portion should be segmented much as a timber cutter does to minimize loss due to cull and to obtain logs of good quality. Where loss from crook or sweep can be eliminated by cutting short logs, no cull volume is assigned. In softwood logs, total cull cannot exceed $66\frac{2}{3}$ percent of the gross board-foot volume. In hardwood factory lumber logs, allowable cull varies with log grade from 40 percent to 50 percent with 60 percent permitted in some cases (Appendix). In hardwood tie and timber logs no interior rot is permitted and surface cull plus cull resulting from sweep or crook cannot exceed 50 percent of the gross board-foot volume.

(7) Maximum taper or drop in log diameter within a saw log cannot exceed $1/2$ the log diameter for any 6-inch section. For example, a drop in scaling diameter from 15 inches just below a whorl of limbs to 7 inches just above the whorl would require terminating the length of a lower log at that point.

- b. Minimum top diameter inside bark for the upper limit of the saw-log portion varies with d.b.h. The length of the saw-log portion is limited by the minimum diameter in all trees with boles that are smooth, sound, and straight. The length of the saw-log portion is shortened for certain defects, thus resulting in top diameters larger than the allowable minimum.

The minimum top diameters inside bark begin at 60 percent of d.b.h. in 10-inch trees and drop 1 percent per inch of d.b.h. to 50 percent at 20 inches d.b.h. and 40 percent at 30 inches d.b.h. A top diameter of 8 inches is the minimum for hardwoods. The minimums in round numbers are listed in section 2.24. A more complete table is given on the coding summary (Appendix).

- c. Minimum sound volume in the saw-log portion is $33\frac{1}{3}$ percent of the gross board-foot volume (International $1/4$ -inch rule) of the section from stump to the upper limit of saw-log merchantability. The top log, even if it is the only log, must be merchantable (a, above). In computing net volume of the saw-log portion, sections not merchantable must be considered 100 percent cull. Thus, net volume = (gross volume) - (cull volume in merchantable logs) - (gross volume of cull sections).

6.45 Top D.i.b.

Diameter inside bark at the top of the saw-log portion (or a similar point in all other trees that are pole-ingrowth size or larger) will be used as one of the variables in the board-foot and cubic-foot volume equations. These estimates should be made as follows:

- a. Sound sawtimber trees will be measured as usual, except that average diameter inside bark (d.i.b.) at the top of the saw-log portion will be estimated and recorded. Obviously diameter cannot be estimated to the nearest tenth inch where the point is at considerable height. Nevertheless, the d.i.b. should be recorded as a 3-digit number. A zero should be used for the tenths digit where an estimate to the nearest inch is the best that can be made. Thus, estimates might be 06.7, 09.2, 11.5, 17.0, 20.0, etc.
- b. Sawtimber ingrowth trees are sound trees that will reach sawtimber size with one year's growth (see the guide to radial growth required for ingrowth, Coding Summary). For these trees d.i.b.(now) should be estimated at the point which will be the top of the saw-log portion after one year's growth.
- c. Cull trees and poletimber trees 5.0 inches or larger will be given a section length similar to the saw-log portion of a sawtimber tree, and also a top d.i.b. for that section. The larger trees not sawtimber ingrowth (b, above) should be treated much the same as sawtimber trees (a, above), while smaller trees should be handled in a special way:
 - (1) Cull trees and poletimber trees 8 inches or larger (not sawtimber ingrowth) should be given a "saw-log portion" including the more or less cylindrical portion of the lower stem. The "upper stem" should include the portion modified by limbs and usually cone-shaped.
 - (2) Smaller poletimber-sized trees (5-inch, 6-inch, 7-inch d.b.h. classes) and cubic-foot ingrowth trees are most strongly affected by changes of d.i.b. in the volume equation. Therefore, accurate d.i.b. estimates for these trees are especially important. Except for cases where there is an abrupt change of form in the stem of these trees, the "saw-log portion" should be reduced to a length that will make it easy to estimate top d.i.b. accurately. For example, a "saw-log portion" of 4 or 5 feet might be used in a 5-inch tree; and a "saw-log portion" of 10 to 15 feet could be used in a 7-inch tree.
- d. Cubic-volume ingrowth trees are to be given a top d.i.b. also, as well as "saw-log portion" lengths and "cordwood" lengths. These are those large saplings that will reach poletimber size with one year's growth. These can be identified by referring to the ingrowth table in the coding summary (Appendix), based on present diameter and radial growth for the past 5 years.
 Record the present top d.i.b. at a point similar to that used for small poletimber trees.
- e. Top d.i.b. in forked trees should be increased slightly to prevent underestimating volumes with volume equations. Adjust as follows:

- (1) In sound sawtimber trees consider only forks containing one or more merchantable saw logs. Add to the top d.i.b. of the longest fork .4 times the top d.i.b. of each minor fork having a saw-log length above the crotch at least $1/2$ the length above the crotch for the longest fork.
- (2) In other trees, add to the top d.i.b. of the longest fork .4 times the top d.i.b. of each minor fork having a cordwood length above the crotch at least $1/2$ the length of the longest fork above that point.

6.46 Saw-log Portion Length

The length of the saw-log portion is measured or estimated and recorded in feet. For sound sawtimber-sized trees, this is the length from stump to the upper limit of the saw-log portion.

All other trees of potential cubic-foot ingrowth size or larger also will be given a "saw-log portion" length corresponding to that given sawtimber trees. This is fully explained in sec. 6.45.

6.47 Cordwood Length

In all trees 5.0 inches d.b.h. or larger this is the length of the tree section from the stump to the minimum top of 4.0 inches outside bark.

In the cubic-foot ingrowth trees described in sec. 6.45, above, this is the cordwood length the tree is expected to have as a poletimber-sized tree with one year's additional growth.

6.48 Board-foot Cull

Volume of board-foot cull is estimated for each growing stock tree of sawtimber size. It is estimated also for each board-foot ingrowth tree. These are trees now poletimber-size that are expected to become sound sawtimber trees with one year's additional growth.

Several estimating aids have been prepared to simplify the job of computing cull volumes. The suggested methods of estimating the different types of board-foot cull are presented as follows:

- a. Sweep (fig. 3,a) is the largest single cause of board-foot cull in sawtimber trees of the Southeastern States. Use the following steps in estimating cull resulting in sweep:
 - (1) Divide the saw-log portion into logs as a timber cutter does to minimize cull and produce high-quality logs.
 - (2) Estimate the sweep departure in inches. If the log has double sweep (sweep in 2 different planes) add the two departures together.
 - (3) Estimate the length of the portion with sweep. If 6 feet or less, treat as crook.
 - (4) Estimate the scaling diameter of the portion of the log with sweep.
 - (5) Enter the tree number in the left-hand column on the back of the plot sheet. Record the sweep dimensions as (a) inches departure, (b) feet length of portion with sweep, and (c) scaling diameter of portion with sweep.

- (6) Look up the corresponding cull volume in the Coding Summary (Appendix) and record it. If the sweep exceeds the maximum allowable sweep, either cull the whole log or divide the logs in a way that reduces the loss from sweep.
 - (7) If a log must be considered as a cull section because of excessive cull, look up the total board-foot volume in the Coding Summary. Record the volume; and change the cull dimensions to "100%" instead of "inches departure" (a,5, above). Thus, the dimensions will be 100%-L-S.
 - (8) Use a separate line on the back of the plot sheet for each occurrence of sweep within the tree.
- b. Crook (fig. 3,b) is an abrupt bend in a log. Short sections of sweep, 6 feet or less, are treated the same as crook. Volume loss from crook should be minimized by separating the logs at the crook wherever possible. Use the following steps in computing cull resulting from crook:
- (1) Divide the saw-log portion into logs.
 - (2) Estimate and record (a) crook departure in inches, (b) length of crooked section, (c) scaling diameter of crooked section. Record by tree number on the back of the plot sheet.
 - (3) Look up the corresponding cull volume in the table provided in the Coding Summary. Record the cull volume.
 - (4) If departure exceeds the allowable maximum, the log or a short section of it should be considered a cull section with 100% cull. In such a case, record "100%" instead of inches departure in the crook dimensions. Look up the volume in the Coding Summary.
- c. Cull sections below forks in sawtimber trees (less than 8 feet between stump and fork) are difficult to estimate because each fork of sawtimber size is considered a separate sawtimber tree. Estimate board-foot cull for each fork of sawtimber size as 100% of the short section length with the scaling diameter equal to d.b.h. (measured above the fork) minus double bark thickness. Compute and record the same as d, below.
- d. Other board-foot cull resulting from butt wounds, large limbs, surface wounds such as lightning scars, and redheart (*Fomes pini*) in pines is estimated as follows:
- (1) Determine the length of the saw-log portion affected by the defect. Estimate what percentage of that section is unusable for lumber, ties, or timbers. Estimate the scaling diameter of the section.
 - (2) Record the cull dimensions on the back of the plot sheet as (a) percent loss, (b) length of section containing the cull, and (c) scaling diameter of the section.

- (3) Look up the section volume in the table in the Coding Summary and record the part of the volume that is board-foot cull.

After the different items of board-foot cull are computed for each tree, the total should be listed under "total cull board feet." The totals should be transferred to the front of the plot sheet by tree number after cubic-foot cull has been computed.

6.49 Cubic-foot Cull

The entire cordwood section of each live ~~cordwood~~ tree 5.0 inches d.b.h. or larger is examined for cubic-foot cull. This is the volume of decayed or missing wood, and volume in sections of the bole that are too rough to be utilized, even by a fuelwood operator. Do not estimate cull in 4-inch cubic-foot ingrowth trees. Sweep is not considered to cause cubic-foot cull. Extremely bad crook may cause short sections to be dropped out as total cull, as do large forks, and large or numerous limbs. In softwoods, no cull volume should be deducted because of sound knots or large limbs that are permitted in a merchantable log.

The section between stump and a fork is considered 100 percent cubic-foot cull in trees forking below 4-1/2 feet. For each fork 5.0 inches d.b.h. or larger, cull is 100 percent of the cull section length with a midpoint d.i.b. 1 to 2 inches larger than d.b.h. minus double bark thickness. The midpoint d.i.b. would depend upon the section length and the normal taper for the species.

Compute cubic-foot cull as follows:

- a. Determine the length of the cordwood section affected. Estimate the percentage of the section that is cull. Estimate the midpoint diameter (i.b.) for the section.
- b. Record the dimensions as (1) percent loss, (2) length of the section, and (3) midpoint diameter (i.b.) of the section.
- c. Look up the section volume in the table provided in the Coding Summary and record the part that is cubic-foot cull.

After the different items of cubic-foot cull have been computed for each tree, the total should be listed under "total cull cu. ft.;" and the totals for board-foot and cubic-foot cull should be transferred by tree number to the front of the plot sheet.

6.5 The Point Sample

The point sample provides a system for describing the conditions on the acre of forest land surrounding plot center. The ~~present and future~~ conditions on the acre are classified on the basis of conditions that exist at 10 points distributed around plot center (fig. 4).

6.51 Running the Point Sample

Observations are made in the 10-point sample after all other plot measurements except site quality are complete. That is, following the timber cut and mortality tally, the variable plot tally of live trees, and measurement of detailed tree data (including the specific gravity sample on designated plots, sec. 7.1).

Usually the measurer should have time to set up the first two points before the crew chief completes measurements on the last sample tree. Then he can keep ahead of the crew chief in setting up the other 8 points. The points are located as follows:

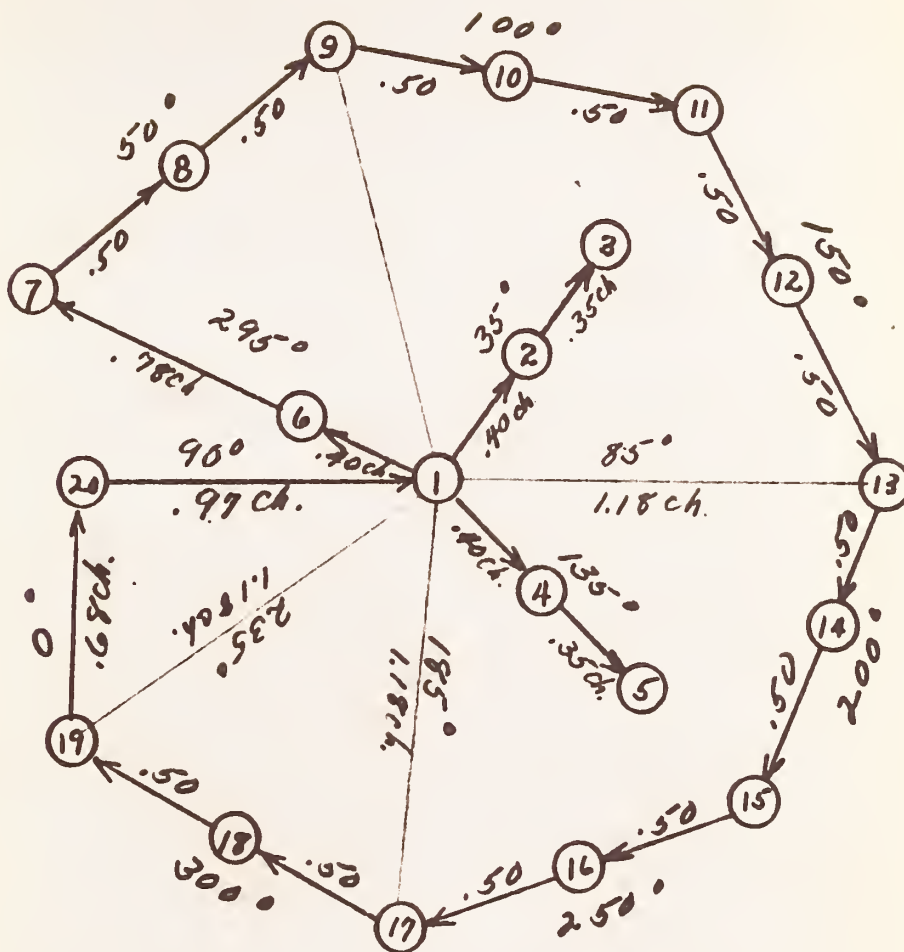


Figure 4.—Layout of the 20-point sample.

Each point is examined for (1) vegetation dominating the area around the point, (2) the presence or absence of a pine seed tree within effective distance of the point, (3) recent disturbance of the area, ~~and (4) prospective stocking of the area with or without treatment~~ (4) treatment, and (5) stocking after treatment.

6.52 Area Covered and Trees Included at Each Point

- a. Tree-size classes.--The tree sizes are as follows:

<u>Tree size</u>	<u>Species</u>	<u>Limits of class</u>
Seedling (including sprouts):	Longleaf pine	1/2" at ground level but less than 1.0" d.b.h.
	Other softwoods	0.5 foot high but less than 1.0" d.b.h.
	Hardwoods	1.0 foot high but less than 1.0" d.b.h.
Small sapling	All species	1.0" d.b.h. but less than 3.0"
Large sapling	All species	3.0" d.b.h. but less than 5.0"
Poletimber:	Softwoods	5.0" d.b.h. but less than 9.0"
	Hardwoods	5.0" d.b.h. but less than 11.0"
Sawtimber:	Softwoods	9.0" d.b.h. or larger
	Hardwoods	11.0" d.b.h. or larger

- b. Area covered at each point.--An angle gauge with the basal area factor of ~~3475~~ square feet per acre will be used to establish the area around the point observed for trees 5.0 inches d.b.h. or larger. With this angle gauge, the limiting distance from the point to the tree in feet is ^{equal to} ~~1.42 times~~ the diameter of the tree in inches. Smaller fixed plots are used for tree seedlings and saplings and all sizes of inhibiting vegetation (see sec. 6.53 for definition). The limiting distances (plot radii) are as follows:

<u>Kind of vegetation</u>	<u>Size class</u>	<u>Limiting distance</u>
Inhibiting vegetation (not tree species)	Any size	3.72
		3.72 feet
Trees	Seedling-size	3.72 feet
Trees	Small sapling-size	4.16
		4.16 feet
Trees	Large sapling-size	4.81
Trees	Poletimber-size or larger	6.88 feet
		Distance in feet is equal to 1.42 times d.b.h. in inches

The scale on the back side of the diameter tape can be used to check radii of the small fixed plots.

The angle gauge should be used to check the limiting distances for trees 5.0 inches d.b.h. or larger. Occasional tests should be made with a tape only to make sure the angle gauge is calibrated properly and is being used in the correct manner.

Insert.

Distance from eye to target on the angle gauge is

$$d = (txPRF)12$$

where t = angle gauge target in inches

PRF = plot radius factor = 75.625/BAF

For a target measuring 1.35 inches with a BAF of 75

$$d = 1.35 \times 1.00 \times 12 = 16.2 \text{ inches.}$$

6.51 Point Classification

At the end of each course between points (fig. 4) the observer will establish a temporary but definite mark, such as a twig, pencil, or pin, and then proceed as follows in classifying and recording point information.

1. Select the most dominant tree within the limiting distance of the point, or the most dominant inhibiting vegetation on the milacre quadrat (radius 3.72 feet) if no tree 1.0 inch and larger is within the limiting distance of the point. Include overtopped and intermediate trees and vegetation on the quadrat as well as dominant and codominant trees and vegetation. Vegetation other than trees is inhibiting if it is large enough and dense enough to interfere with the natural or artificial establishment of a desirable seedling on the milacre quadrat. Ignore vegetation other than trees if not inhibiting at the present time.
2. Record the crown class (sec. 2.32, page 5) on the last line of the point tally. If the point is nonstocked, record a crown class 0 if half or more of the milacre is receiving light from above and class 5 if less than one-half. Ignore isolated branches extending from the main periphery of the crown of the tree in determining overtopping.
3. Record the following items of information on the first 4 lines of the point sample tally for each point:

(Continue with item a. on page 48)

~~For the second observation at the point, (1) there are not two trees that qualify as stocking the point, and (2) there is not sufficient space at least 5.27 feet from the only stocking tree or only open space to permit the establishment and development of a free-growing tree.~~

~~The following items of information are recorded on the first 4 lines of the point sample tally for each of the 2 observations at each point:~~

- a. Tree class.--The same tree classes (sec. 2.35 and 6.44) used in the variable-plot tree tally are used to describe trees observed in the point sample. The only differences are that Code 0 has been added to indicate no stocking, and Code 7 has been added for stocking by inhibiting vegetation.
- b. Species.--The tree species codes used in the variable-plot tally are used for the point sample. Dash the space for unstocked observations and those stocked with inhibiting vegetation.
- c. Diameter class.--Record the 2-inch diameter class (d.b.h. class) for the tree, shrub, etc., stocking the observation. Use 0 for seedlings, shrubs, etc., less than 1.0 inch at the point of d.b.h. measurement, 2 for those 1.0 inch but less than 3.0 inches, 4 for those 3.0 inches but less than 5.0 inches, etc.

Estimate the diameter classes instead of making actual measurements. All crew members quickly become skilled at estimating tree diameters through work on the variable plots, and can estimate 2-inch diameter class with satisfactory accuracy.

- d. Competitive class.--The following definitions of competition and overtopping should be kept in mind while determining competitive class of each observation.

Competition, as used in the point sample, is the reduction of optimum growth or the hindrance to normal development of a ~~desirable growing stock~~^{crop}/tree by the crown of another tree, shrub, etc., in the same general crown level or a higher level, but not directly above the crown of the affected tree. Competition in this case could have, but does not necessarily have, a 2-way effect between the trees involved.

Overtopping, as used in the point sample, is the partial or complete extension of the crown of a tree, shrub, etc., over the crown of a ~~desirable~~^{crop}/tree. Overtopping may exist even though less than half the crown of the affected tree is covered.

One of the following competitive class codes is recorded for each observation at each point in the point sample:

Observation stocked with ~~desirable~~^{crop} tree

Code

- 0 Free from competition or overtopping by vegetation ~~either on or off~~ the point
- 1 Receiving competition from another/~~desirable~~^{crop} tree ~~either on or off~~ the point
- 2 Receiving competition from or overtopped by other vegetation (not a ~~desirable~~^{crop} tree) ~~either on or off~~ the point

Observation unstocked or stocked with other than ^{crop}/desirable tree

Code

- 3 Competing with or overtopping a ^{crop}/desirable tree on the point
- 4 Observation stocked but not competing with or overtopping a ^{crop}/desirable tree on the point
- Observation not stocked. (Dash the space.)

6.54 Pine Seed Source at the Point

A code for seed source is recorded once for each point, not for each observation at the point. Because of the uncertainty of obtaining adequate natural regeneration from longleaf pine, a separate code is used to indicate that longleaf is the only pine seed source at the point. To qualify as a seed tree, the pine (a) must be at least 9.0 inches d.b.h., (b) must be open-grown, dominant, or co-dominant, (c) must be expected to survive for at least 10 years, and (d) must be within a distance from the point not exceeding the total height of the tree.

Use the following pine seed source codes:

- Code 0 No pine seed tree present
- Code 1 A pine seed tree other than longleaf is present
- Code 2 No pine seed tree is present except longleaf pine

6.55 Disturbance at the Point

One code for disturbance is recorded for each point, ~~not each observation.~~

A disturbance is defined here as any action other than growth or natural regeneration occurring in the past 3 years which changed the tree class or tree diameter class, ~~of either observation at a point.~~ The disturbance may or may not have had a detrimental effect on the stand.

The following disturbance classes and codes are used:

- | <u>Code</u> | <u>Type of disturbance</u> |
|-------------|--|
| 0 | No disturbance |
| 1 | Disturbance from cutting |
| 2 | Disturbance from clearing, breaking up sod or litter, exposing soil, etc., not accompanied by planting |
| 3 | Disturbance from girdling and/or use of silvicides, not accompanied by planting |
| 4 | Disturbance from fire |
| 5 | Disturbance from insects |
| 6 | Disturbance from disease |
| 7 | Disturbance from other destructive agencies such as wind, lightning, flooding, grazing, etc. |
| 8 | Disturbance caused by planting not accompanied by site preparation (such as listed for Code 2 or 3, above) |
| 9 | Disturbance caused by planting accompanied by site preparation (such as listed for Code 2 or 3, above) |

6.56 Treatment Needed at the Point

This is the general type of action needed to get the point stocked with at least one acceptable dominant or codominant crop tree free from competition or overtopping. Record one of the following codes on each of the two observations at each point:

Code

- 0 No treatment, observation stocked with acceptable crop tree free of competition or overtopping.
- 1 Thinning, crop tree receiving competition from an on-point tree of equal quality; free crop tree from competing tree of equal quality.
- 2 Stand improvement, crop tree receiving competition or overtopping from on-point undesirable vegetation; free crop tree from less desirable trees or vegetation.
- 3 Natural regeneration with site preparation, stocked with noncrop tree or shrubs, adequate seed source, reasonable expectation of natural regeneration if undesirable vegetation is removed.
- 4 Natural regeneration without site preparation, nonstocked, seed source adequate, seedling plot not overtopped, seed source adequate, reasonable expectation of natural regeneration without treatment.
- 5 Planting with site preparation, no seed source, little or no chance of adequate stocking with a crop tree without removing the unwanted vegetation and planting.
- 6 Planting without site preparation, no seed source, nonstocked, can be planted without removal of inhibiting vegetation.
- 7 Regeneration on lowland sites, suitable crop tree: not available, pine regeneration not practical. Only thinning and stand improvement are regarded as valid treatments on physiographic classes 7, 8, and 9.

Crop trees are acceptable low quality or better (tree classes 1, 2, and 3) on sites 1 and 2 on physiographic classes 7, 8, and 9, and acceptable high quality or better (tree classes 1 and 2) on all other areas.

8 Hardwood polelimber tree

9 Hardwood sawtimber tree

Record azimuth and distance from end of last course (from point 20 to point 1) to plot center at the bottom of the plot sheet.

6.6 The Plot Description

After the tally, detailed measurements, and point sample have been completed, most of the plot description blanks on the plot sheet are filled in by the party chief. Several of the classifications are obvious and can be recorded quickly; but some items require simple computations. (See sec. 5 for information about nonforest plots.)

6.61 Information Recorded by the Party Chief

The following classifications or other items of information are supplied before the field crew leaves the plot:

a. Plot identification

- (1) Survey unit.--See Appendix.
- (2) County.--See back of photo or county code list (Appendix).
- (3) Plot number.--See photo.
- (4) Photo number.--See photo.
- (5) Grid number.--See photo.
- (6) Plot class.--See sec. 4.1.

b. Land use

The land use classes defined in section 2.41 are listed here with their codes. One additional class, other cleared land (P.I. Code 6), is the photo interpreter's classification for agricultural lands not considered cropland.

<u>Code</u>	<u>Land use class</u>
1	Commercial forest land
	Noncommercial forest land
2	Unproductive forest land
3	Productive forest reserved
5	Cropland
6(P.I.)	Other cleared land
6	Improved pasture
7	Idle or abandoned cropland
8	Marsh and prairie
9	Urban and other areas
0	Non-Census water

- (1) P.I. land use.--Code is recorded on back of photo.
- (2) Ground land use.--Base on present conditions; codes above, definitions section 2.41.
- (3) Cause of land-use change, section 2.42.

c. Forest land ownership

Each forest plot will be classified as to type of owner and size of forest ownership. Also, each cleared plot is to be classified as to type and size of ownership that applied immediately before the area changed from forest to some other land use.

- (1) Ownership class.--The following ownership classes are recognized:

<u>Code</u>	<u>Ownership class</u>
1	National forest
2	Other public
3	Pulp and paper manufacturer
4	Lumber manufacturer
5	Other forest industry
6	Farmer, not leased to forest industry
7	Farmer, leased to forest industry
8	Other private, not leased to forest industry
9	Other private, leased to forest industry

All lands administered by the U. S. Forest Service are classified as national forest.

Other public lands include other lands (not national forest) owned by Federal, state, county, or municipal governments or under lease for a period of 50 years or more.

Farmer-owned lands are forest lands owned by operators of farms. A farm operator is a person who operates a farm, either performing the labor himself or directly supervising it. This classification also includes any forest land owned by a farm operator which is not directly a part of the farm.

In cases where an owner operates a wood-using plant the holding should be classed as forest industry if the wood-using operation is of significant commercial importance. (Very small "farm" sawmills producing lumber only for home use, or mills producing less than 100 MBF annually would not be considered of commercial importance.) Otherwise, the holding should be classed as farmer-owned.

Consider farmer-owned or other private lands as leased to a forest industry if the forest industry holds a lease for the use and management of the lands for any length of time. A timber lease in connection with an ordinary timber sale would not qualify the property as leased to a forest industry.

Forest industry lands include forest lands owned by either primary or secondary manufacturers. For example, a lumber planing mill would be considered a lumber manufacturer even though it does not saw lumber from logs.

- (2) Ownership size.--Each forest plot (or cleared plot) will be classified as to acreage of commercial forest land in the United States held by the owner. This includes the total commercial forest owned whether it is in a single tract or more than one tract. The following ownership size classes are recognized:

<u>Code</u>	<u>Ownership size (commercial forest)</u>
0	Less than 20 acres
1	20 through 39 acres
2	40 through 59 acres
3	60 through 79 acres
4	80 through 99 acres
5	100 through 499 acres
6	500 through 2,499 acres
7	2,500 through 4,999 acres
8	5,000 through 49,999 acres
9	50,000 acres or more

The breakdown of ownership size classes may be changed at the end of the third survey of North Carolina. Precise acreage information in the smaller size classes are needed to decide upon the best breakdown to be used in future surveys.

Actual acreage of commercial forest ownership will be recorded for ownerships of less than 100 acres. Exact commercial forest acreage will be recorded also for each ownership of 100 acres or more, if that figure is obtained in the process of placing the ownership in the proper size class. In other words, obtain exact figures for all ownerships with less than 100 acres of commercial forest, but do not go to extra expense for actual figures on larger

ownerships if the ownership size class can be assigned correctly without precise acreage figures. Spaces are provided on the plot tally sheet (Form 3) for both ownership class and ship size class. ~~and actual acres of commercial forest~~

d. Stand size

Stand size is based on the point-sample stocking of growing-stock trees (tree class 1, 2, 3, or 4). Definitions given in sec. 1x52 will be repeated here in slightly different form:

<u>Code</u>	<u>Stand size class</u>
0	<u>Nonstocked</u> .--Fewer than 2 observations stocked with growing-stock trees
2	<u>Seedling-sapling</u> .--At least 2 observations stocked with growing-stock trees; and more than half this stocking in seedlings or saplings.
3	<u>Poletimber</u> .--At least 2 observations stocked with growing-stock trees with half or more in poletimber or sawtimber, and stocking in poletimber trees exceeds that in sawtimber trees.
4	<u>Sawtimber</u> .--At least 2 observations stocked with growing-stock trees with half or more in poletimber or sawtimber trees, and with sawtimber stocking at least equaling poletimber stocking.

e. Forest type (current survey)

Forest type is based on the point-sample stocking of live trees, including all tree classes. The following forest types occur in the Southeastern States:

Softwood types.--These are forest plots with pine, hemlock, redcedar, spruce, or fir singly or in combination stocking 50 percent or more of the point-sample observations that are stocked with tree species.

Where no species or group of species stocks a plurality of observations because 2 or more stock an equal number of observations, the one that appears most dominant on the acre should determine the type.

Softwood types are further separated into the following groups:

- (1) Yellow pine types.--These are softwood types having a plurality of the softwood observations (excluding cypress and Atlantic whitecedar) stocked with yellow pines or redcedar. In yellow pine types with mixtures of yellow pine species, the species stocking the greatest number of observations determines the type. The following yellow pine types are recognized:

<u>Code</u>	<u>Forest type</u>
01	Longleaf pine
05	Slash pine
13	Loblolly pine (includes spruce pine)
14	Shortleaf pine (includes pitch pine, Table-mountain pine and redcedar)
15	Pond pine
16	Sand pine
17	Virginia pine

- (2) Other softwood types.--These are softwood types in which yellow pines do not predominate. They are softwood types in which the named species singly or in combination stock a plurality of the softwood observations. The following are recognized:

<u>Code</u>	<u>Forest type</u>
21	White pine-hemlock
23	Spruce-fir

Hardwood-yellow pine type - Code 40. This type includes stands with more than 50 percent of the stocked observations stocked with hardwoods (including cypress and Atlantic white-cedar) but with at least 25 percent of the observations stocked with yellow pines or redcedar.

Hardwood types.--These are forest plots with hardwoods, cypress, or Atlantic white-cedar singly or in combination stocking more than 50 percent of the point-sample observations that are stocked with tree species, and less than 25 percent of this stocking in yellow pines or redcedar. The following hardwood types are recognized in the Southeast:

<u>Code</u>	<u>Forest type</u>
51	<u>Hard maple-beech-yellow birch.</u> --A hardwood type with over 50 percent of the hardwood observations stocked with sugar maple, beech, or yellow birch. This is an upland type that occurs in the Appalachian Mountains as well as in the northern states. <u>Do not include</u> stands in lowlands that contain beech or Florida maple.
61	<u>Oak-hickory.</u> --A hardwood type with 50 percent or more of the hardwood observations stocked with upland hardwood species such as upland oaks, hickory, yellow-poplar, and gums, but not qualifying as hard maple-beech-yellow birch type. Yellow-poplar coves are included in this forest type.
62	<u>Scrub oak type.</u> --A hardwood type with over 50 percent of the hardwood observations stocked with scrub oak species.
81	<u>Bench-hardwood.</u> --A hardwood type in a choice bottomland or stream-margin site. In the broad river-bottoms, this type occurs on the benches of deep silt above the first bottom or on small ridges in the first bottom. It usually extends up to the area

<u>Code</u>	<u>Forest type (continued)</u>
81	occupied by pine or upland hardwoods. Species such as cherrybark oak, swamp chestnut oak, shumard oak, white oak, sweetgum, or yellow-poplar usually predominate in this type.
82	<u>Water oak-gum.</u> --A hardwood type in the moist riverbottom or stream-margin sites. In the broad riverbottoms this type usually occupies the upper portion of the first bottom between the wet gum-cypress sites and the bench hardwood sites. In a narrow riverbottom it may be the only type present. Species such as water oak, laurel oak, willow oak, elm, red maple, and blackgum usually predominate in this type.
83	<u>Gum-cypress.</u> --A hardwood type (include cypress and white-cedar) in a wet or swampy site with over 50 percent of the hardwood points stocked with water tupelo, blackgum, cypress, ash, Ogeechee tupelo, and white-cedar. Do not include upland hardwood stands even if 50 percent or more of the tree cover density is in blackgum or ash.

f. Original type

Since the original Forest Surveys of North Carolina and Virginia were made, the forest type specifications have been changed more than once. In order to obtain estimates of area changes in forest types between surveys, it is necessary to classify each forest plot on the basis of the original type definitions.

Original types are based on number of dominant and codominant stems of commercial species on the 1/5-acre fixed plot at the location of the variable plot. Each forest plot should be assigned one of the following types:

Pine and pine-hardwood types.--Stands in which pines, hemlock, redcedar, spruce, or fir make up 25 percent or more of the dominant or codominant stems on the 1/5-acre with the named species predominating:

<u>Code</u>	<u>Original type</u>
1	Longleaf pine-hardwoods (includes slash pine)
2	Pond pine-hardwoods
3	Loblolly pine-hardwoods
4	Shortleaf pine-hardwoods (includes pitch and Table-mountain pine)
5	Virginia pine-hardwoods
6	White pine-hemlock-hardwoods (includes spruce and fir)

Hardwood types.--Stands in which hardwoods, cypress, or Atlantic white-cedar make up more than 75 percent of the dominant or codominant stems on the 1/5-acre.

<u>Code</u>	<u>Original type</u>
7	Bottomland hardwoods
8	Upland hardwoods (includes scrub oak without longleaf pine stocking)

In the sandhill and coastal sections of North Carolina, areas that once supported longleaf pine may now be dominated by scrub oak. Scrub oak stands with 5 percent stocking of longleaf pine or as many as 4 longleaf pine seed trees per acre are classified as longleaf pine-hardwood (Code 1).

g. Physiographic classes

Each forest plot is assigned a physiographic class based on topography, aspect, soil, moisture, and drainage. None of the following classes is confined to a single topographic region (mountains, piedmont, or coastal plain).

<u>Code</u>	<u>Physiographic class</u>
1	<u>Mountain tops and dry mountain slopes.</u> --This includes the mountain ridge tops and most of the steep slopes with a western or southern exposure.
2	<u>Mountain saddles and moist mountain slopes.</u> --Broad gaps in mountain ridges and the moist slopes, usually with northern or eastern exposures.
3	<u>Coves and valley bottoms.</u> --Mountain coves and valley floors, well drained, and usually having deep soil.
4	<u>Piedmont uplands (excluding deep sands).</u> --This class includes the well-drained, rolling uplands occupying much of piedmont and foothills. Include the narrow drains (less than 2 chains wide) passing through piedmont uplands.
5	<u>Deep sands.</u> --Areas of deep sands, usually dry and hilly or rolling, occurring ordinarily at the upper limit of the coastal plain or near the ocean.
6	<u>Flatwoods and dry pocosins.</u> --Flat or fairly level areas, ordinarily with sandy soil, and dry throughout most of the year.
7	<u>Well-drained bottomlands and broad stream margins.</u> --The deep-soiled bench sites and broad well-drained stream margins.
8	<u>Moist stream bottoms.</u> --The shallow-soiled stream bottoms (at least 2 chains wide) intermittently flooded for short periods.
9	<u>Deep swamps, ponds, wet pocosins, and strands.</u> --Forest areas wet or flooded for long periods.

h. Site class

Each forest plot and each nonforest plot with cutting is assigned a site class. These classes are based on the capacity of the site to produce cubic-foot volume of wood. Site curves (Appendix) have been constructed for several species providing four classes

of maximum mean annual growth per acre for a fully stocked stand. The classes are as follows:

<u>Code</u>	<u>Mean annual growth per acre</u>
1	0 to 50 cu. ft.
2	50 to 85 cu. ft.
3	85 to 120 cu. ft.
4	120 cu. ft. or more

The site curves have been constructed using total height and total age of dominant trees to obtain site class. A pine site tree should be used for pine and hardwood-pine types and a hardwood for hardwood types. The site tree measurements from the old plot sheet may be used where the site tree fits the present forest type.

A pine site tree may be selected either on or near the plot; but do not select a hardwood site tree closer than 1 chain from plot center. We wish to avoid risk of increment borer damage in hardwoods that are now or eventually will be in the variable-plot tally of our permanent plots.

Select a dominant tree that has never been open grown, intermediate, or overtopped, preferably between the ages of 20 and 50. Where possible use a species for which a site curve is provided. To the tree age at d.b.h., add 9 years for longleaf pine, 4 years for other softwoods, and 2 years for hardwoods. In addition, to site class, record the species, total height, total age, and d.b.h. of the site tree used.

i. Cutting history

Each plot is assigned a code to indicate whether or not cutting, girdling, poisoning, bulldozing, etc., of trees within the minimum size took place during the cutting period. On old plots (class 1 and 2 plots) this cutting period is the time since the last survey. On new plots it is 3 years. Codes 1 through 8 apply only where the cubic-foot volume of timber cut amounted to 10 percent or more of the volume that was on the 1/5-acre plot before cutting began. In cases where more than one type of cutting has taken place on the plot during the cutting period, the kind of cutting that removed the largest volume should apply.

Notice that the odd numbered cutting history codes 1, 3, 5, and 7 apply to plots on which a full tally of cut trees can be made, but even numbers are used for plots that have had one or more stumps removed. A plot with cutting history Code 9 may or may not have a full tally; but if it does not, a note on the plot sheet points out the fact that one or more stumps have been removed. It is important that correct cutting history codes be used because averages will be used to supply part or all the timber cut volume on plots without full cut tally. Average volume of ingrowth trees cut will be added to class 1 and 2 plots with stumps removed and to all class Code 5 plots. Average volume of the full cut tally will be added to other plots with stumps removed.

It is necessary to include in our timber cut computations the timber volume that is lost because of suburban development, building new rural homes, etc., where some of the trees remain standing but the area is no longer forest. Plots that changed from forest to

a nonforest land use during the cutting period and have one or more trees 5.0 inches d.b.h. or larger still standing are considered as cutover whether or not actual cutting took place. In such a case, both trees that were cut and trees that are standing on nonforest land are tallied as timber cut. If half or more of the original volume was used, the cutting history is cutting for farm or local use, Code 3 or 4. If over half of the original volume is still standing or was cut but not used, the cutting history is clearing without use of trees, Code 7 or 8.

The cutting history classes are as follows:

<u>Code</u>	<u>Cutting history</u>
0	<u>No cutting</u> on 1/5-acre plot in the cutting period.
1	<u>Commercial logging</u> operation with full stump tally. Ten percent or more of 1/5-acre plot volume cut. (Include plots with commercial cutting in conjunction with clearing if a full stump tally can be made.)
2	<u>Commercial logging</u> operation with some or all stumps removed. Ten percent or more cut. (Include plots with commercial cutting in conjunction with clearing where a full stump tally cannot be made.) No cut trees tallied except old tally trees on class 1 and 2 plots.
3	<u>Cutting for farm or local use</u> with full stump tally. Ten percent or more cut. (Include cleared plots with full stump tally if the trees were utilized for farm or local use. Include plots changed to nonforest land use during the cutting period with trees still standing, full tally, and at least half of volume used.)
4	<u>Cutting for farm or local use</u> with some or all stumps removed. (Include cleared plots with some or all stumps removed if trees were utilized for farm or local use. Include plots changed to nonforest land use in the cutting period with trees still standing, some of stumps removed, but at least half of volume used.) Only cut trees tallied are old tally trees on class 1 and 2 plots.
5	<u>Noncommercial thinning or cultural work</u> with full stump tally. Ten percent or more cut or deadened.
6	<u>Noncommercial thinning or cultural work</u> with some or all stumps removed. Ten percent or more cut or deadened. No cut trees tallied except old tally trees on class 1 and 2 plots.
7	<u>Clearing without use of trees removed</u> with full stump tally. Ten percent or more cut or deadened. (Include plots changed to nonforest land use during the cutting period with trees still standing, full tally, and over half of volume still standing or cut but not used.)
8	<u>Clearing without use of trees</u> with some or all of stumps removed. Ten percent or more cut or deadened. (Include plots changed to nonforest land use within the cutting period with trees still standing, some of stumps removed,

Code Cutting history (continued)

- 8 but over half of volume still standing or cut but not used.) Only cut trees tallied are old tally trees on class 1 and 2 plots.
- 9 Cutting of less than 10 percent of the plot volume. Include any type of cutting, clearing, poisoning, etc., with removal of at least one tree within the minimum size, but with reduction of less than 10 percent in the cubic-foot volume of the 1/5-acre plot. If one or more stumps were removed, make a note to that effect on the plot sheet.

j. Previous stand size

Previous stand size is recorded for each forest plot that had cutting, girdling, poisoning, clearing, etc., or mortality during the cutting or mortality period. The stand size that existed immediately before cutting or mortality applies. Where more than one cutting occurred or more than one tree died during the cutting period, the stand size that existed before the first of these should be used. The appearance of the stand on the photo, the present stand, and the number and size of stumps can be used in establishing the previous stand size. It should be kept in mind that stem diameter usually drops 2 inches or more between a 1-foot stump and d.b.h. Base previous stand size on the acre as for the stand size classification used on inventory plots (sec. 6.61, d).

No previous stand size is recorded for a plot that did not qualify as forest at the time of cutting. In such a case make a note under "field notes" fully explaining the situation.

k. Previous forest type

Previous forest type is recorded for each forest plot that had cutting, girdling, poisoning, clearing, etc., or mortality during the cutting or mortality period. This is the forest type that existed before cutting, clearing, etc., took place. Base previous forest type on the acre.

No previous forest type is recorded for a plot that was not forest at the time of cutting.

l. Planting history

Each forest plot is assigned one of the following planting history codes:

- | <u>Code</u> | <u>Planting history</u> |
|-------------|---|
| 0 | No evidence of artificial planting or seeding of forest trees on the acre. |
| 1 | Seventy percent or more of the trees on the acre originated from artificial planting or seeding. |
| 2 | The acre was partially planted or seeded, with fewer than 70 percent of the trees originating from planting or seeding. |

m. Disturbance

The disturbance code (sec. 6.55) other than Code 0 that occurs on a plurality of point-sample observations is recorded as plot disturbance. If no disturbance has a plurality because two or more classes were assigned to equal numbers of observations, record the one that predominates on the acre. If only Code 0 occurred, record that.

n. Crew

The initials of the crew members are recorded with those of the man recording the tally entered first.

o. Date

Record the date of the plot measurement.

p. Field notes

Witness tree data (sec. 4.72) and plot slope (sec. 4.74) should have been recorded as the plot was established.

Other notes should be made to explain measurements or classifications that might be questioned by the person making a check cruise or editing the plot sheet.

The recording of wood naval stores data, to be done in certain areas, will be covered later (sec. 7.2).

6.62 Information Recorded in the Asheville Office

In order to simplify the work of the field crews and reduce the amount of time required on the plots, a considerable amount of the descriptive information will be recorded in the Asheville office. This will be done along with the editing work.

Spaces on the plot sheet that are to be completed in the Asheville office are shaded lightly for easy identification. Other shaded spaces not in the plot description also are to be completed in the Asheville office.

Details of this phase of the job are covered in "Forest Survey Instructions for Editing Field Records."

6.7 Editing the Tally Sheet in the Field

As soon as the plot sheet has been filled out completely, it is edited by the measurer. This is done before the crew leaves the plot. He should edit all items on the plot sheet for completeness and all classifications for accuracy. However, he need not recompute volumes unless he questions the accuracy of some classification that requires it. The measurer should initial the plot sheet in the space for field notes when he is satisfied with the accuracy and completeness of the entries.

Detailed instructions for editing of records by the measurer, crew chief, group leader, and field supervisor are included in the "Forest Survey Instructions for Editing Field Records."

7 SPECIAL SURVEYS

From time to time the Forest Survey crews will make special surveys or gather special information along with the regular plot measurement work.

7.1 Specific Gravity Sample

Specific gravity of pines, hemlock, spruce, and fir will be sampled in North Carolina and Virginia. Every fifth forest plot in each county is designated as a specific gravity sample plot and marked as such on the photo and county map. Each pine and hemlock tree on these plots that is bored for radial growth is also used as a specific gravity sample. In addition to this, each spruce or fir tree bored for radial growth on any plot is included in the sample. Each core is measured, labeled, and preserved for mailing to Asheville; and a separate form per county is used by each crew to summarize the measurements and identify the cores.

One boring should be made on the plot-center side of the tree 4.5 feet above ground. Care should be taken to insert the borer perpendicular to the axis of the bole and aimed at the center of the tree. In case the center is missed slightly, do not bore again if the borer passed close enough to the center to permit accurate age determination. If the borer is not long enough to reach the center, take as long a core as possible and underline core length with a heavy line to indicate that the center was not reached.

After radial growth has been recorded, the core is trimmed and measured. Trim the core so as to square off the inner end and just remove the pith center or, if it missed the pith, cut it at the point adjacent to the center. Trim the outer end so as to remove the most recent incomplete season's growth and the bark. Immediately after trimming, measure the length of the core to the nearest hundredth inch.

On the specific gravity sample form, record (a) plot number, (b) tree number, (c) species, (d) d.b.h., (e) core length in inches and hundredths, and (f) core diameter in thousandths of an inch. Core diameter is the diameter of the opening in the increment borer bit. Use only bits that have been measured and marked with core diameter.

The sample core is inserted in a soda straw that has been labeled with the county code, the plot number, and tree number, as 011-17-3. Then both ends of the straw are crimped and it is placed in a container to prevent damage to it before reaching the vehicle. A core that is too long for the straw should be cut and placed in two straws marked A and B, as 011-17-3A and 011-17-3B.

The boring, trimming of the core, and labeling should be done by the measurer; but the measurement of length should be done by the crew chief because the scale is taped to his sheetholder.

As soon as the county is completed, the cores should be securely packed in a mailing tube and mailed to the Asheville office. The specific gravity record forms should be folded in the middle, rolled to fit the mailing tube, and mailed in the tube with the cores.

The cores will be sent to the Forest Products Laboratory for determination of specific gravity and core age. Later on, analyses will be made of the relationships of specific gravity and the other tree data collected by Forest Survey. It is believed that specific gravity may prove to be an important factor in evaluating timber for certain products and, therefore, might be used to good advantage in wood procurement, forest management programs, forest genetics advances, etc.

7.2 Wood Naval Stores

The wood naval stores industry is dependent upon the supply of old-growth longleaf and slash pine stumps. Practically no old-growth stands remain, so it

is important to know the present quantity of stumpwood and the proportions immediately and potentially available.

7.21 Wood Naval Stores Stumps Tallied

In the coastal plain of North Carolina (Units 1 and 2), each field sample plot, both forest and nonforest, will be checked for wood naval stores stumps. A tally of seasoned old-growth longleaf pine stumps will be made on the 1/5-acre plot having a center common with the current inventory or nonforest plot.

Green or second-growth longleaf and slash pine stumps are not considered merchantable and are not included. Old-growth stumps of other species are included only if (1) they are rich in resin, and (2) there is at least one seasoned old-growth longleaf or slash pine stump on the plot. In such situations, exact species is difficult to identify and stump operators push all rich stumps.

7.22 Stump Availability Classification

Stump availability is classified for each field sample plot, both forest and nonforest. Ordinarily the circular acre around plot center is considered; but in narrow strips or near the boundaries of different land uses, the acre should be restricted to the land use in which the plot falls.

One of the following classifications is given each forest and nonforest sample plot:

<u>Code</u>	<u>Availability class</u>
0	<u>No stump</u> on the circular acre around plot center
1	<u>Merchantable area.</u> The acre contains one or more stumps and falls in an area of stumps at least 25 acres in extent. The ground is firm enough to permit hauling stumps and the timber, if any, is open enough to permit bulldozers to operate. Small scattered accessible areas which are reasonably close together and aggregate 25 acres or more in total area should be considered merchantable.
2	<u>Marginal area.</u> The acre contains one or more stumps but falls in an area of stumps less than 25 acres in extent. Include in this class small areas of stumps where the surrounding area has been worked out.
3	<u>Potential area.</u> The acre contains one or more stumps and falls in an area of stumps at least 25 acres in extent. The ground will permit equipment to operate, but due to the present dense growth of growing-stock trees, operation would result in excessive damage. Destruction of cull trees should not be considered as preventing stump operations.
4	<u>Inaccessible area.</u> The acre contains one or more stumps and falls in an area of stumps at least 25 acres in extent. However, natural obstacles such as swamps or waterways prevent either access or operation. Reference to aerial photos should help in judging accessibility.

8 RECORDS AND REPORTS

The ability to make accurate, neat, and legible records is required of each timber cruiser on Forest Survey. Unless the records are neat and legible, errors are bound to creep into the results even though the observations and measurements are made with precision.

8.1 Photos and Maps

All aerial photos, index sheets, and maps are part of the permanent record of the Forest Survey. They should be maintained in good condition and should be mailed with the weekly reports to the field supervisor as the assigned work is completed.

8.2 Progress Records

The following records of progress are made by each field crew to prevent missing field plots and to help the crew, the field supervisor, and the Asheville office in planning the work.

8.21 Marking Completed Plots on the County Map

Small red circles on the county map represent the approximate location of each field sample plot. As soon as a plot is completed, the small circle should be filled in with a pencil. Thus, the crew can see at a glance the areas already complete and the work that remains in the county.

8.22 Field Plot Record

Forest Survey Form 7 (Appendix), listing all the field plots by photo number, is made out in duplicate by the photo interpreter; and both copies are sent to the field with the photos and map for each county. Each week before the completed plot sheets are sent in, they should be checked off on Form 7. The crew's copy of the form is sent to the field supervisor with the last of the plot sheets for the county.

8.23 Weekly Progress Report

The Weekly Progress Report is completed in duplicate each week. The original is sent with the plot sheets and photos to the field supervisor, and the copy is sent to the Asheville office. This report serves the following purposes:

- a. It summarizes the week's work by county and indicates the number of plots remaining in each of those counties.
- b. It provides data on effective time, lost time, and vehicle mileage which are necessary in computing costs.
- c. The form is used to keep the field supervisor and office informed about the crew's mailing address and place of temporary residence.
- d. It provides space for use in making requests for supplies, equipment, etc.

The Weekly Progress Report should be made out and mailed the evening of the last work day of each week (usually Friday evening).

8.24 Transmittal of Field Records to the Asheville Office

Plot sheets, photos, index sheets, and maps ordinarily should be held by the field supervisor until all the work in the county is completed. Promptly thereafter, they should be sent to Asheville by certified mail.

8.3 Vehicle Maintenance Reports

8.31 Equipment Operation Log

Each Forest Survey vehicle is supplied with an Equipment Log Book in which daily mileages, costs, inspections, etc., are recorded. The summary sheet should be completed at the end of the month and sent to the Asheville office with other reports.

8.32 Vehicle Inspection Reports

Each Forest Survey vehicle is to receive a maintenance check every 1,000 miles and an inspection by a mechanic every 6,000 miles. Detailed instructions are given in section 3.23.

8.4 Diary and Expense Account

Each U. S. Forest Service employee is to submit an official diary and an expense account to the Asheville office on the last day of the month. The expense account is typed in Asheville and sent back for approval and signature of the employee. It should be returned to Asheville immediately.

8.5 Field Purchases

U. S. Forest Service employees are authorized to make purchases of needed supplies, rent vehicles or boats, and pay for repairs, etc., the following ways:

8.51 Credit Cards

A U. S. Government National Credit Card (Standard Form 149) is furnished for each Forest Survey vehicle. Charges for gasoline (regular grade only), oil, lubrication, tire repairs, and wash jobs should be paid with the credit card. Vehicle F. I. number must be recorded on the bill. The customer's copies of bills should be sent to Asheville each week with the weekly reports.

8.52 Field Purchase Orders

Each party chief on U. S. Forest Service crews is furnished a book of purchase order forms. They should be used for purchases and repairs amounting to \$15 or more. It is important that each crew chief learn to fill out and submit purchase orders in the correct manner.

8.53 Cash Purchases

Payments in cash up to \$15 may be made by a U.S.F.S. employee and collected on the expense account without receipts. Signed receipts are needed to support larger cash payments. Cash payments of over \$25 should not be made except in emergencies. A copy of each telegram that is sent should be mailed in with the expense account.

9 ACCURACY OF WORK

9.1 Field Inspections

The field supervisor makes periodic on-the-job inspections of the work of each crew. He should work with experienced crews at least one day every six weeks, and with new crews as often as their training needs indicate. During these inspections he can find and eliminate sources of error, improve uniformity of information collected by different crews, improve crew efficiency, and give followup training where needed.

9.2 Check Cruises

The field supervisor makes check cruises of each crew's work at intervals of about six weeks. He checks a randomly selected group of 3 to 5 forest and nonforest plots from those that were established by the crew since the previous check cruise. New crews are taken back on the plots for the check; but the work of experienced crews is checked independently by the field supervisor as long as an adequate level of accuracy is maintained.

Check cruise plots are completely retaken and the results are compared with the original in all respects including location, tally, measurements, and classifications. A copy of each original plot record and the check cruise is sent to

the crew along with a summary (Appendix) of the results. As long as four or more crews are in the field, a summary of results by crew and the combined results are sent to each crew. However, only the identity of the crew receiving the report is indicated.

The results of the check cruise should be studied carefully by members of the field crew before they are mailed to Asheville with the next weekly report.

9.3 Performance Ratings

Soon after a new employee begins work with the Southeastern Station, a Performance Requirements Sheet is prepared. It lists the main tasks that the employee does on the job, and indicates the performance of each task that is considered acceptable. These tasks and the performance requirements are discussed with each employee by his supervisor. At the end of the year each employee is given a rating by his supervisor on each of these tasks.

If the employee is promoted or transferred to a different job with the Station, a new Performance Requirements Sheet is prepared.

The employee's attitude toward the job, accuracy of work, rate of production, neatness of records and reports, care of equipment, and safety practices are all taken into account in giving the ratings. Performance is, of course, the primary factor considered in extending employment beyond the probationary period, in picking men for jobs of responsibility, and in recommending them for promotion.

10 SPECIAL STUDIES

Certain studies are necessary to obtain information required on Forest Survey but not readily collected by the regular field crews. Special equipment is needed for some studies. A separate sampling system is necessary for utilization studies, and experience and special training is essential in both utilization studies and log-grade studies. Certain tasks that could be performed by the field crews may be added to the special studies in order to streamline the job of the field crew and simplify crew training. Some studies must be repeated in each state with each resurvey. Apparently this is true of utilization studies. Information on bark thickness and stump taper surely does not change appreciably between surveys. The special studies needed will vary state by state, but they can be grouped as follows:

10.1 Utilization Studies

These studies usually are statewide and always conducted on samples of active cutting operations. Recent studies of this kind were made in Florida and Georgia, and another is planned for North Carolina.

10.2 Volume-table Studies

Tree-measurement data have been collected throughout the Station territory for use in constructing volume tables and volume estimating equations. Plans have been made to collect additional volume-table data for white pine, hemlock, and Virginia pine in North Carolina.

10.3 Other Studies

Other studies are made from time to time to obtain special information or to try out new procedures or new equipment. Minor studies have been made to determine the rate of deterioration of cut stumps, to check on utilization of butt logs in turpentine trees, to test the feasibility of using 1-man crews, etc. Time studies are made occasionally to determine the cost of collecting certain information, and to point out areas for improvement in the efficiency of Forest Survey field crews.

11 APPENDIX

NORTH CAROLINA COUNTY CODES AND MAGNETIC DECLINATIONS

USED IN THE SECOND SURVEY OF NORTH CAROLINA

North Carolina Survey Unit No. 1

<u>County</u>	<u>County Code</u>	<u>Declination</u>	<u>County</u>	<u>County Code</u>	<u>Declination</u>
Bladen	009	3°00'W	Lenoir	054	4°00'W
Brunswick	010	3°00'W	Moore	063	2°30'W
Columbus	024	3°00'W	New Hanover	065	3°30'W
Cumberland	026	3°00'W	Onslow	067	4°00'W
Duplin	031	3°30'W	Pender	071	3°30'W
Greene	040	4°00'W	Richmond	077	2°30'W
Harnett	043	3°00'W	Robeson	078	2°30'W
Hoke	047	2°30'W	Sampson	082	3°30'W
Johnston	051	3°30'W	Scotland	083	2°30'W
Jones	052	4°00'W	Wayne	096	4°00'W
Lee	053	3°00'W			

North Carolina Survey Unit No. 2

Beaufort(TRR)	007	5°00'W	Hyde	048	--
Bertie	008	--	Martin	059	--
Camden	015	--	Nash(TRR)	064	4°00'W
Carteret	016	--	Northampton	066	--
Chowan	021	--	Pamlico	069	--
Craven	025	--	Pasquotank	070	--
Currituck	027	--	Perquimans(TRR)	072	6°00'W
Dare	028	--	Pitt	074	--
Edgecombe	033	--	Tyrrell	089	--
Gates	037	--	Washington	094	--
Halifax	042	--	Wilson	098	--
Hertford(TRR)	046	5°30'W			

North Carolina Survey Unit No. 3

Alamance	001	--	Mecklenburg	060	--
Alexander	002	--	Montgomery	062	--
Anson	004	--	Orange	068	--
Cabarrus(TRR)	013	2°00'W	Person	073	--
Caswell	017	--	Polk(TRR)	075	1°00'W
Catawba	018	--	Randolph(TRR)	076	3°00'W
Chatham	019	--	Rockingham(TRR)	079	3°00'W
Cleveland	023	--	Rowan	080	--
Davidson	029	--	Rutherford	081	--
Davie	030	--	Stanly	084	--
Durham(TRR)	032	3°30'W	Stokes	085	--
Forsyth	034	--	Surry	086	--
Franklin	035	--	Union	090	--
Gaston(TRR)	036	1°30'W	Vance(TRR)	091	4°00'W
Granville	039	--	Wake	092	--
Guilford	041	--	Warren	093	--
Iredell	049	--	Yadkin	099	--
Lincoln	055	--			

North Carolina Survey Unit No. 4

<u>County</u>	<u>County Code</u>	<u>Declination</u>	<u>County</u>	<u>County Code</u>	<u>Declination</u>
Alleghany	003	--	Jackson	050	--
Ashe	005	--	McDowell(TRR)	056	1°00'W
Avery	006	--	Macon(TRR)	057	0°30'E
Buncombe	011	--	Madison	058	--
Burke	012	--	Mitchell	061	--
Caldwell	014	--	Swain	087	--
Cherokee	020	--	Transylvania	088	--
Clay	022	--	Watauga(TRR)	095	1°30'W
Graham	038	--	Wilkes	097	--
Haywood	044	--	Yancey	100	--
Henderson	045	--			

TREE SPECIES

Commercial Tree Species

Yellow pines

<u>Code</u>	<u>Common name</u>	<u>Scientific name</u>
00	Longleaf pine, round	Pinus palustris
01	Longleaf, front-faced	
02	Longleaf, back-faced	
03	Longleaf, idle	
04	Longleaf, worked-out	
05	Slash pine, round	P. elliotii (all varieties)
06	Slash, front-faced	
07	Slash, back-faced	
08	Slash, idle	
09	Slash, worked-out	
10	Pitch pine	P. rigida
11	Spruce pine	P. glabra
12	Table-mountain pine	P. pungens
13	Loblolly pine	P. taeda
14	Shortleaf pine	P. echinata
15	Pond pine	P. serotina
16	Sand pine	P. clausa
17	Virginia pine	P. virginiana

Other softwoods

21	White pine	Pinus strobus
22	Hemlock	Tsuga sp.
23	Spruce	Picea sp.
	Fir	Abies sp.
25	Baldcypress	Taxodium distichum var. distichum
26	Pondcypress	Taxodium distichum var. nutans
27	Redcedar	Juniperus sp.
28	Atlantic white-cedar	Chamaecyparis thyoides
29	Northern white-cedar	Thuja occidentalis

Soft hardwoods

31	Blackgum	Nyssa sylvatica (all varieties)
32	Water tupelo	N. aquatica
33	Yellow-poplar	Liriodendron tulipifera

Soft hardwoods (continued)

<u>Code</u>	<u>Common name</u>	<u>Scientific name</u>
34	Sweetgum	Liquidambar styraciflua
35	Cottonwood	Populus sp.
36	Red maple	Acer rubrum
	Silver maple	A. saccharinum
	Boxelder	A. negundo
37	Basswood	Tilia sp.
38	Cucumber	Magnolia acuminata
39	Magnolia	M. sp. except acuminata and virginiana
40	Sweetbay	M. virginiana
41	Loblolly-bay	Gordonia lasianthus
42	Willow	Salix sp.
43	Buckeye	Aesculus sp.
44	Elm	Ulmus sp.
45	Hackberry	Celtis sp.
46	Sycamore	Platanus occidentalis
47	Black cherry	Prunus serotina
48	Butternut	Juglans cinerea
49	Silverbell (in mountains only)	Halesia sp.

Hard hardwoods

50	White oak	Quercus alba
51	Swamp chestnut oak	Q. michauxii
52	Chinkapin oak	Q. muehlenbergii
	Bur oak	Q. macrocarpa
53	Swamp white oak	Q. bicolor
55	Post oak	Q. stellata, except var. margaretta
56	Chestnut oak	Q. prinus
57	Overcup oak	Q. lyrata
58	Live oak	Q. virginiana
60	Northern red oak	Q. rubra
61	Cherrybark oak	Q. falcata var. pagodaefolia
	Shumard oak	Q. shumardii
63	Scarlet oak	Q. coccinea
	Pin oak	Q. palustris
	Shingle oak	Q. imbricaria
64	Southern red oak	Q. Falcata
65	Black oak	Q. velutina
67	Water oak	Q. nigra
	Laurel oak	Q. laurifolia
	Willow oak	Q. phellos
71	Hickory and pecan	Carya sp.
72	Ash	Fraxinus sp.
73	Beech	Fagus grandifolia
74	Sugar maple	Acer saccharum
	Florida maple	A. barbatum
75	Birch (except yellow)	Betula sp. except alleghaniensis
76	Yellow birch	B. alleghaniensis
77	Black locust	Robinia pseudoacacia
78	Honeylocust	Gleditsia triacanthos
	Mulberry	Morus sp.
79	Black walnut	Juglans nigra
80	Flowering dogwood	Cornus florida

Hard hardwoods (continued)

<u>Code</u>	<u>Common name</u>	<u>Scientific name</u>
81	Holly	Ilex opaca
82	Persimmon (forest grown)	Diospyros virginiana
90	Scrub oaks (blackjack, bluejack, turkey, dwarf post, etc.)	Quercus marilandica, incana, laevis, stellata var. margaretta, etc.
91	Australian pine (Florida only)	Casuarina sp.
92	Cajeput-tree (Florida only)	Melaleuca laucadendron
93	Blue beech	Carpinus caroliniana
	Persimmon (old-field grown)	Diospyros virginiana
	Sourwood	Oxydendrum arboreum
	Catalpa	Catalpa sp.
	Chinaberry	Melia azedarach
	Fire cherry	Prunus pensylvanica
	Hophornbeam	Ostrya virginiana
	Sassafras	Sassafras albidum
	Ogeechee tupelo	Nyssa ogeche
	Osage orange	Maclura pomifera
	Redbay	Persea sp.
	Redbud	Circis canadensis
	Serviceberry	Amelanchier sp.
	Silverbell (except in mountains)	Halesia sp.
	Ailanthus	Ailanthus altissima
	Royal paulownia	Paulownia tomentosa
	American mountain-ash	Sorbus americana
	Planertree	Planera aquatica
	Apple (domestic)	Malus sp.
	Striped maple	Acer pensylvanicum
	Mountain maple	A. spicatum
	Chalk maple	A. leucoderme
95	Cabbage palmetto (Florida only)	Sabal palmetto

YELLOW PINES		NONCOMMERCIAL		LAND-USE CLASS		CAUSE OF DAMAGE OR DEATH	
00	Longleaf, round	90	Scrub oaks (black-jack, bluejack, turkey, dwarf post, etc.)	1	Com. forest	<u>DISEASE</u>	
01	Longleaf, front-f.			2	Unprod. forest	<u>OTHER</u>	
02	Longleaf, back-f.			3	Prod. forest, reserved	0- None	-0 None
03	Longleaf, idle			5	Cropland	1- Littleleaf	-1 Southern pine beetle
04	Longleaf, worked-o.	91	Australian pine	6	Imp. pasture (or P.I. oth. clear.)	2- Fusiform	-2 Ips
05	Slash, round	92	Cajuput-tree	7	Idle or abandoned	3- Oak wilt	-3 Black turpentine beetle
06	Slash, front-f.	93	Blue beech	8	Marsh or prairie	4 Other major disease	-4 Ips and black turp. beetle
07	Slash, back-f.		Persimmon (old-field grown)	9	Urban and other	5- Littleleaf and fusiform	-5 Unlisted insect only
08	Slash, idle			0	Non-census water	6- Littleleaf and other major disease	-6 Fire without bark beetle
09	Slash, worked-o.		Sourwood			7- Fusiform and other major disease	-7 Windthrow or lightning
10	Pitch		Catalpa			8- Oak wilt and other major disease	-8 Other known physical cause
11	Spruce		Chinaberry				-9 Unknown cause
12	Table-Mt.		Fire cherry	<u>CAUSE OF L. U. CHANGE</u>			
13	Loblolly		Hophornbeam	0	No change	<u>TREE CROWN CLASS</u>	
14	Shortleaf		Sassafras	1	Clearing or nonfor. develop.	GUIDE TO RADIAL GROWTH REQUIRED	
15	Pond		Ogechee tupelo	2	Reversion to forest	FOR INGROWTH (GRO. FACTOR 2.27)	
16	Sand		Oseage orange	3	Unproductive forest	SOFTWD. 4" OR 8", HDWD. 4" OR 10" DBH	
17	Virginia		Redbay	4	Change in nonforest use		
			Redbud	5	Misclassification		
			Serviceberry				
			Silverbell (except in mts.)	<u>CLASS OF OWNERSHIP</u>			
21	White pine		Ailanthus	1	National forest	<u>TREE CLASS</u>	
22	Hemlock		Royal paulownia	2	Other public	0	Nonstocked
23	Spruce and fir		American mt.-ash	3	Pulp and paper	1	Desirable
25	Baldcypress		Planertree	4	Lumber manufacturer	2	Acceptable, high qual.
26	Pondcypress		Apple (domestic)	5	Other forest industry	3	Acceptable, low qual.
27	Redcedar		Striped maple	6	Farmer, not leased	4	Acceptable, salvage
28	Atlantic wht.-cedar		Mountain maple	7	Farmer, leased to for. ind.	5	Sound cull
29	Northern wht.-cedar		Chalk maple	8	Other private, not leased	6	Rotten cull
			Cabbage palmetto (Florida only)	9	Other private, leased to for. ind.	7	Other inhib. veg.

SWEEP DEDUCTION IN BOARD-FEET

Sweep:Sweep :		Scaling diameter of section with sweep (In.)															
dep.:length:		(In.): (Ft.): 6 : 7 : 8 : 9 : 10 : 12 : 14 : 16 : 18 : 20 : 22 : 24 : 26 : 28															
2	6	1	1	2	2	3	3	4	5	6	6	7	8	9	9		
	8	1	1	2	2	3	4	5	6	7	8	9	10				
	10	1	1	2	2	3	4	5	6	7	8	9	10				
	12	1	1	2	2	3	4	5	6	7	8	9	10				
	14	1	1	1	1	1	2	2	3	3	4	4	5				
	16	0	0	0	0	0	0	0	0	0	0	0	0				
3	6	2	3	3	4	5	6	7	9	10	11	13	14	15	17		
	8	2	3	4	5	6	7	9	10	12	14	15	17	19	20		
	10	2	4	5	6	6	8	10	12	13	15	17	19	20	22		
	12	3	4	5	6	7	9	11	12	14	16	18	19	21	23		
	14	3	4	5	6	7	9	10	12	14	16	17	19	21	23		
	16	3	4	5	6	6	8	10	11	13	14	16	18	19	21		
4	6	3	4	5	6	7	8	11	13	15	17	18	20	22	24		
	8	4	5	6	7	9	11	14	16	18	21	23	25	28	30		
	10	5	6	8	9	10	13	16	19	21	24	27	29	32	35		
	12	5	6	8	10	12	14	18	20	23	26	29	32	35	38		
	14	6	8	9	11	12	16	19	22	25	28	31	35	38	41		
	16	6	8	10	11	13	16	19	23	26	29	32	35	39	42		
5	6	5	6	8	9	11	14	16	19	22	24	27	29	32			
	8	5	7	8	10	12	15	18	21	24	27	31	34	37	40		
	10	6	8	10	12	14	18	21	25	29	33	36	40	44	48		
	12	8	10	12	16	20	25	29	33	37	41	45	50	54			
	14	9	11	13	16	18	22	27	32	36	41	45	50	54	59		
	16	10	12	15	17	20	24	29	34	39	44	48	53	58	63		
6	6	8	9	11	14	17	20	24	27	30	33	36	39				
	8	11	12	14	18	22	26	30	34	38	42	46	50				
	10	10	13	15	18	23	27	32	36	41	46	51	56	60			
	12	12	15	18	21	26	32	37	42	48	53	58	64	69			
	14	11	15	18	20	23	27	32	36	41	47	53	59	65	71		
	16	13	16	20	23	26	32	39	45	52	58	64	71	77	83		
7	6	11	13	16	21	24	28	32	36	39	43	47					
	8	15	17	22	27	31	36	41	46	51	56	60					
	10	19	21	27	33	39	44	50	56	62	67	73					
	12	22	25	32	39	45	52	58	65	71	78	84					
	14	25	29	36	44	51	58	66	73	81	88	95					
	16	24	28	33	40	49	57	64	72	80	88	96	104				
8	6	19	24	28	33	37	41	46	50	54							
	8	25	31	37	42	48	54	59	65	70							
	10	30	37	46	53	61	69	76	84	92	100						
	12	34	43	52	61	69	78	87	96	105	113						
	14	34	43	52	61	69	78	87	96	105	113						
	16	34	39	48	58	68	77	87	97	106	116	125					
9	6	27	32	37	42	47	52	57	62								
	8	29	36	42	48	55	61	68	74	80							
	10	37	44	52	60	67	75	83	91	99							
	12	43	52	61	70	80	88	97	106	115							
	14	50	61	71	81	91	101	111	121	131							
	16	57	68	79	90	102	113	124	135	146							

In blank spaces excessive sweep culls the entire section. Boxed spaces are sound for softwoods, but cull for hardwoods.

CROOK DEDUCTION IN BOARD-FEET

Crook:Crook :		Scaling diameter of section with crook (In.)															
dep.:length:		(In.): (Ft.): 6 : 7 : 8 : 9 : 10 : 12 : 14 : 16 : 18 : 20 : 22 : 24 : 26 : 28															
1	1	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
	2	0	0	0	0	1	1	1	1	1	2	2	2	2	2	2	2
	3	1	1	1	1	1	1	2	2	2	2	2	3	3	3	3	4
	4	1	1	1	1	1	2	2	3	3	3	3	4	4	4	5	5
	5	1	1	1	1	2	2	3	3	4	4	5	5	6	6	6	7
	6	1	1	2	2	2	3	3	4	4	5	5	6	6	7	7	8
2	1	0	0	0	1	1	1	1	1	1	1	2	2	2	2	2	3
	2	1	1	1	1	1	2	2	2	2	3	3	3	4	4	4	5
	3	1	1	2	2	2	3	3	4	4	5	5	6	6	7	7	8
	4	1	1	2	2	3	3	4	4	5	6	6	7	8	8	9	10
	5	1	2	2	3	3	4	5	6	6	8	10	10	11	11	13	15
	6	2	2	3	4	4	5	7	8	9	10	12	13	14	15		
3	1	0	0	1	1	1	1	2	2	2	2	3	3	3	3	4	
	2	1	1	2	2	2	2	3	3	4	4	5	5	6	6	7	7
	3	1	2	2	3	3	4	5	6	7	8	9	10	11	12	13	15
	4	2	2	3	3	4	5	6	8	9	10	11	12	13	15		
	5	2	3	4	4	5	6	8	10	11	13	15	17	19	21		
	6	2	3	4	5	6	8	11	13	15	18	20	23	25	27	30	
4	1	1	1	1	1	2	2	3	3	4	4	5	5	6	6		
	2	1	2	2	2	3	3	4	5	6	7	8	9	10	11	12	
	3	1	2	3	4	4	5	7	8	9	10	11	12	13	15		
	4	2	3	4	4	5	7	9	10	12	13	15	17	18	20		
	5	3	4	5	6	7	9	11	13	15	17	19	21	22	25		
	6	3	5	6	7	8	11	13	15	18	20	23	25	27	30		
5	1	2	2	2	3	3	4	4	5	6	7	8	9	10	11	12	
	2	2	3	4	4	5	6	7	8	9	10	11	12	14	16	17	19
	3	4	4	5	7	8	10	11	12	13	15	17	19	21	22	25	
	4	5	6	6	9	11	13	15	17	19	21	24	26	28	31		
	5	6	7	8	11	13	16	19	23	25	29	32	34	38			
	6	8	9	10	13	16	19	23	26	29	32	34	38				
6	1	2	2	3	3	4	4	5	6	6	7	8	9	10			
	2	3	4	5	6	7	9	10	11	12	13	15	17	18	20		
	3	4	5	6	8	10	12	13	15	17	19	20	22				
	4	5	6	8	10	12	13	15	18	20	23	25	27	30			
	5	9	10	13	16	19	23	25	29	32	34	38					
	6	11	13	16	20	23	27	31	34	38	41	45					
8	1	3	5	6	7	8	9	10									
	2	7	9	10	12	13	15	17	18	20							
	3	10	13	16	18	20	23	25	27	30							
	4	14	17	20	24	27	30	34	36	40							
	5	17	22	26	30	34	38	42	45	50							
	6	21	26	31	36	41	46	51	54	60							
10	1	6	7	8	10	11	12										
	2	12	14	16	19	21	23	25									
	3	19	22	25	28	31	34	37									
	4	26	29	34	37	41	45	49									
	5	32	37	42	47	52	57	62									
	6	39	45	51	57	63	69	75									

In blank spaces crook exceeds the maximum that is allowed. Boxed spaces are sound for softwoods, but cull for hardwoods.

BOARD-FOOT VOLUME OF SHORT LOGS

DIB :		Length of log or section (ft.)													
am. end:		1	2	3	4	5	6	8	10	12	14	16			
6	1	2	2	3	5	8	10	13	16	19					
7	1	3	4	5	8	12	15	19	24	28					
8	2	4	6	8	12	17	22	27	33	39					
9	3	5	8	10	16	22	29	36	43	51					
10	3	7	10	13	21	29	37	46	55	65					
11	4	9	13	17	26	36	46	57	68	80					
12	5	10	16	21	32	44	57	69	83	97					
13	6	13	19	25	39	53	68	83	99	117					
14	8	15	23	30	46	63	80	98	117	136					
16	10	20	31	41	62	84	108	131	156	183					
18	13	26	40	53	81	109	139	169	200	232					
20	15	30	46	62	92	124	157	192	231	271					
22	21	41	62	82	125	169	214	259	306	354					
24	25	50	74	99	151	203	257	311	368	424					
26	29	59	88	118	179	241	304	368	435	501					
28	35	69	104	138	210	281	356	430	507	584					
30	40	80	120	160	243	325	411	497	585	674					
32	46	92	137	183	278	373	470	568	669	770					
34	52	104	156	208	316	423	534	644	758	873					
36	59	117	176	235	356	477	601	725	853	982					
38	66	132	197	263	398	533	672	811	954	1,096					
40	73	146	220	293	443	593	747	902	1,060	1,218					

LOG GRADES FOR HARDWOOD FACTORY LUMBER LOGS (Third-best face in butt log)

		Scaling diameter of log																											
Log length	:	8	9	10	:	11	12	:	13	:	14	:	15	:	16	:	18	:	20	:	22	:	24	:	26				
	:	Log grade																											
	:	3	3	2	3	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	
8-ft. logs																													
Clear cuttings:																													
Min. length		2	2	-	2	-	2																						
Max. number		4	4	-	4	-	4																						
Min. total length		4	4	-	4	-	4																						
Max. sweep, inches		5	5	4	6	-	6																						
Max. crook, inches		4	4	-	5	-	5																						
Max. total cull, bd.-ft.2/		8	11	-	14	-	18																						
10-ft. logs																													
Clear cuttings:																													
Min. length		2	2	8	2	3	2	8	3	2	8	3	2	8	3	2	8	3	2	8	3	2	8	3	2	8	3	2	2
Max. number		5	5	1	5	2	5	1	2	5	1	2	5	1	2	5	1	2	5	1	2	5	1	2	5	1	2	5	
Min. total length		5	5	8	5	7	5	8	7	5	8	7	5	8	7	5	8	7	5	8	7	5	8	7	5	8	7	5	
Max. sweep, inches		5	6	4	6	5	7	3	5	7	3	5	8	4	6	9	4	6	9	4	7	10	5	8	12	5	8	13	
Max. crook, inches		4	4	3	5	3	6	2	4	6	2	4	7	2	4	8	3	5	8	3	5	9	3	6	10	3	7	11	
Max. total cull, bd.-ft.2/		11	14	18	18	23	23	23	28	28	27	34	34	32	40	40	37	46	46	43	54	54	56	69	69	70	87	87	
12-ft. logs																													
Clear cuttings:																													
Min. length		2	2	10	2	3	2	10	3	2	10	3	2	5	3	2	5	3	2	3	3	2	3	3	2	3	3	2	
Max. number		6	6	1	6	2	6	1	3	6	1	3	6	1	3	6	2	3	6	2	3	6	2	3	6	2	3	6	
Min. total length		6	6	10	6	8	6	10	8	6	10	8	6	10	8	6	10	8	6	10	8	6	10	8	6	10	8	6	
Max. sweep, inches		6	6	4	6	5	7	3	5	8	3	5	8	4	6	9	4	6	9	4	7	10	4	8	12	5	8	13	
Max. crook, inches		4	4	3	5	3	6	2	4	6	2	4	7	2	4	8	3	5	8	3	5	9	3	6	10	3	7	11	
Max. total cull, bd.-ft.2/		13	18	23	23	28	28	28	34	34	33	41	41	39	49	49	46	57	57	52	65	65	68	84	84	85	106	106	
14-ft. logs																													
Clear cuttings:																													
Min. length		2	2	7	2	3	2	7	3	2	7	3	2	7	3	2	5	3	2	5	3	2	3	3	2	3	3	2	
Max. number		7	7	2	7	2	7	2	3	7	2	3	7	2	3	7	2	3	7	2	3	7	2	3	7	2	3	7	
Min. total length		7	7	12	7	9	7	12	9	7	12	9	7	12	9	7	12	9	7	12	9	7	12	9	7	12	9	7	
Max. sweep, inches		6	6	5	7	5	7	4	5	8	4	6	8	4	6	9	4	6	9	4	7	10	4	7	11	5	8	12	
Max. crook, inches		4	4	3	5	3	6	2	4	6	2	4	7	2	4	8	3	5	8	3	5	9	3	6	10	3	7	11	
Max. total cull, bd.-ft.2/		16	21	27	27	34	34	33	41	41	40	49	49	47	58	58	54	67	67	62	78	78	86	100	100	100	125	125	
16-ft. logs																													
Clear cuttings:																													
Min. length		2	2	7	2	3	2	7	3	2	7	3	2	7	3	2	5	3	2	5	3	2	3	3	2	3	3	2	
Max. number		8	8	2	8	2	8	2	3	8	2	3	8	2	3	8	2	3	8	2	3	8	2	3	8	2	3	8	
Min. total length		8	8	13	8	11	8	13	11	8	13	11	8	13	11	8	13	11	8	13	11	8	13	11	8	13	11	8	
Max. sweep, inches		6	6	5	7	5	8	4	6	8	4	6	9	4	6	10	4	7	10	5	7	11	5	8	12	5	9	13	
Max. crook, inches		4	4	3	5	3	6	2	4	6	2	4	7	2	4	8	3	5	8	3	5	9	3	6	10	3	7	11	
Max. total cull, bd.-ft.2/		19	25	32	32	40	40	39	48	48	46	57	57	54	68	68	63	78	78	72	90	90	93	116	116	116	145	145	
18-ft. logs																													
Clear cuttings:																													
Min. length		2	2	7	2	3	2	7	3	2	7	3	2	7	3	2	5	3	2	5	3	2	3	3	2	3	3	2	
Max. number		9	9	2	9	2	9	2	3	9	2	3	9	2	3	9	2	3	9	2	3	9	2	3	9	2	3	9	
Min. total length		9	9	15	9	12	9	15	12	9	15	12	9	15	12	9	15	12	9	15	12	9	15	12	9	15	12	9	
Max. sweep, inches		6	7	5	7	6	8	4	6	8	4	6	9	4	6	10	4	7	10	5	7	10	5	8	11	5	8	12	
Max. crook, inches		4	4	3	5	3	6	2	4	6	2	4	7	2	4	8	3	5	8	3	5	9	3	6	10	3	7	11	
Max. total cull, bd. ft.2/		22	30	37	37	47	47	44	55	55	54	67	67	62	77	77	72	90	90	82	102	102	106	132	132	132	165	165	

1/ Do not consider sweep and crook within the same section of a log. Compute limits for logs over 26", as sweep departure minus 1" per 8' of sweep length cannot exceed 1/6 scaling diameter of section affected for Grade 1, 1/3 for Grade 2, and 1/2 for Grades 3 and 4. Crook cannot exceed 1/6 diameter for Grade 1, 1/3 for Grade 2, and 1/2 for Grades 3 and 4.

2/ A Grade 2 log is permitted 1.2 times the listed maximum cull if it qualifies for Grade 1 otherwise, and a Grade 3 log is permitted 1.2 times the listed maximum cull if it qualifies for Grade 2 otherwise.

HARDWOOD TIE AND TIMBER GRADE																	
(Examine entire log)																	
Scaling diameter.--8-inch minimum																	
Log length.--8-foot minimum																	
Knots or Limbs:																	
Single knot or limb does not exceed 1/3 stem diameter at point of occurrence.																	
Grouped knots or limbs.--Sum of diameters in any 6-inch stem section does not exceed 1/3 stem diameter at point of occurrence.																	
Maximum sweep allowed (inches departure)1/																	
Log :Maximum sweep by log scaling diam.																	
length: 8 :10:12:14:16:18:20:22:24: 26																	
8	5	6	7	8	9	10	11	12	13	14							
10	5	6	7	8	9	10	11	12	13	14							
12	6	6	8	8	9	10	12	13	14	14							
14	6	7	8	9	10	11	12	13	14	15							
16	6	7	8	9	10	11	12	13	14	15							
18	6	7	8	9	10	11	12	13	14	15							

1/ See Footnote 1 above.

Maximum crook allowed.--Departure in inches not to exceed 1/2 diameter of log segment at point of occurrence.
Internal rot.--None allowed.
Total cull.--Not over 50% of gross board-foot volume.

SOUTHERN PINE GRADES

(Examine entire log)

K = Number of overgrown knots + sum of diameters of sound knots + twice the sum of diameters of unsound knots.

D = Scaling diameter of log, small end, inside bark.

Bad Knot = Any knot over 1/6D, or any unsound knot.

Tentative Grades

Grade 1.--D = 17" or more, and D is as large as 5K.

Grade 2.--Not grade 1, but D = 10" or more, and D is as large as 2K.

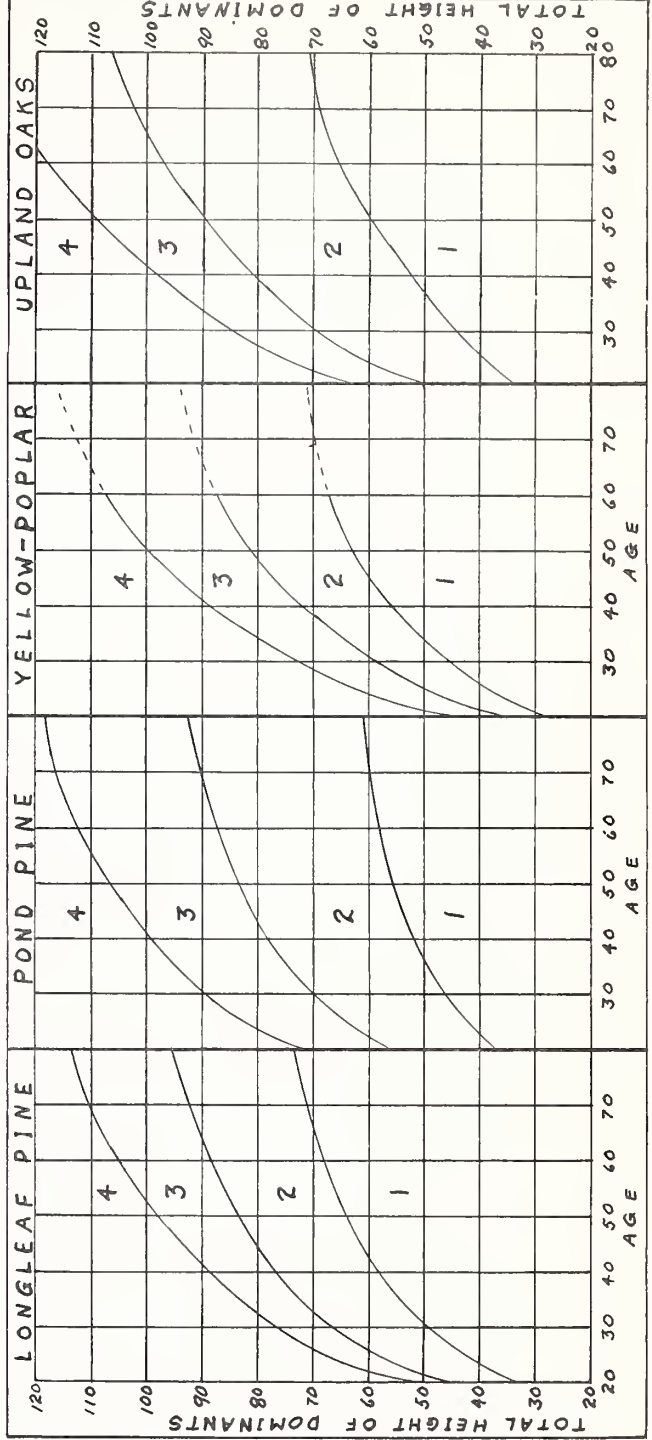
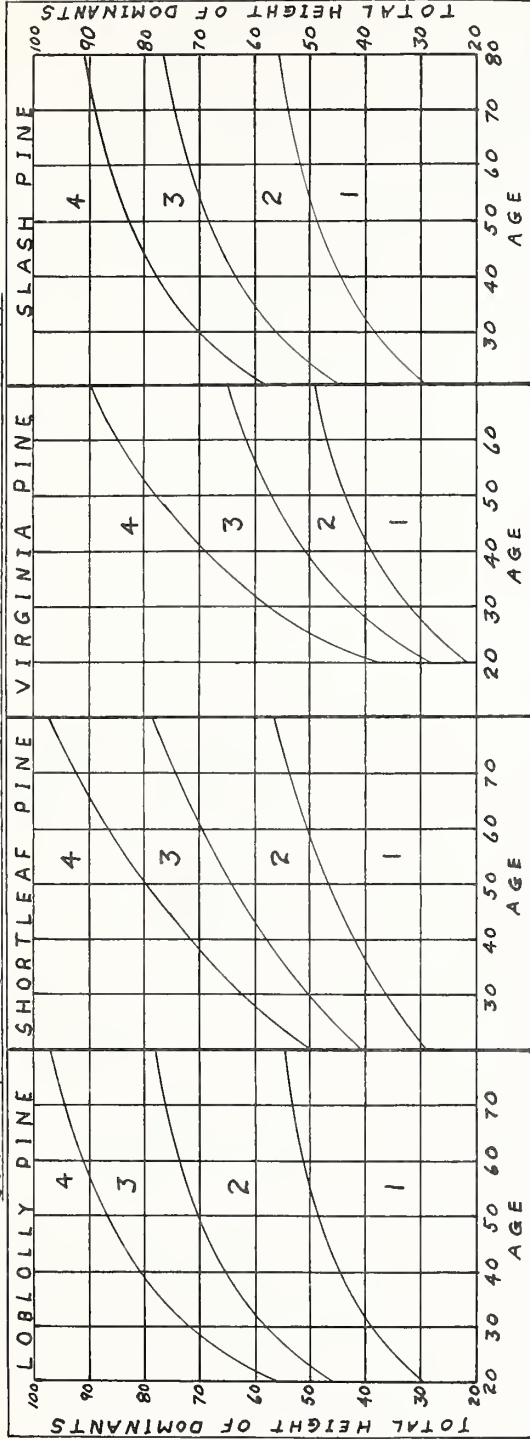
Grade 3.--D is less than 10", or D is less than 2K.

Reduce for Sweep or Bad Knots

a. Reduce any tentative grade by one grade if D is not over 3 times any sweep of 3 inches or more.

b. Then reduce Grade 3 to Grade 4 if all bad knots are not in one face running 1/4 of log length.

SITE CLASS BASED ON CULMINATION OF MEAN ANNUAL GROWTH



FOREST SURVEY
FORM 3 - 1961

PLOT TALLY
SHEET

TALLY OF LIVE TREES ON VARIABLE PLOT

TALLY OF CUT AND MORTALITY

		AZIMUTH	DISTANCE	TREE NUMBER	DBH	SPECIES	CROWN CLASS	DAMAGE	RADIAL GRO.	GRADE	TREE CLASS	SAWLOG		CORDWD. LGTH.	CULL		OLD DBH CLASS	SPECIES	CUT/MORT.	CAUSE DEATH	TREE CLASS	DBH NOW OR STUMP DOB	HT. OF DOB, FT.	STUMP CLASS	PERIOD (YRS.)	NUMBER OF TREES
												TOP DIB	LENGTH		BOARD FEET	CUBIC FEET										
W. C., 4	UNIT			1	:																					
COUNTY				2	:																					
PLOT NUMBER				3	:																					
PHOTO	GRID			4	:																					
PLOT CLASS				5	:																					
P.I. LAND USE				6	:																					
GROUND LAND USE				7	:																					
CAUSE L. U. CHG.				8	:																					
OWNERSHIP CL.				9	:																					
SIZE OF OWNER.				10	:																					
STAND SIZE				11	:																					
FOREST TYPE				12	:																					
ORIGINAL TYPE				13	:																					
PHYSIO. CLASS				14	:																					
SITE CLASS				15	:																					
SPEC.	HT.			16	:																					
AGE	DBH			17	:																					
CUT HISTORY				18	:																					
PREVIOUS SIZE				19	:																					
PREVIOUS TYPE				20	:																					
PLANTING HIST.				21	:																					
DISTURBANCE				22	:																					
CONDITION CL.				23	:																					
TREATMENT				24	:																					
ALL PINE				25	:																					

CARD	STOCKING	POINT SAMPLE													
		POINT NUMBER	1	2	3	4	5	6	7	8	9	10			
	ALL GR. STK.	TREE CLASS													
	CULL TREES	SPECIES													
	OTH. INH. VEG.														
	LIVE TREE	DIAMETER CLASS													
	CUT/MORT.	COMPETITIVE CLASS													
AREA EXPAN. FACT.		PINE SEED SOURCE													
		DISTURBANCE													
CREW		TREATMENT													
DATE		PROS. STOCK. WITH TREAT.													
WITNESS TREE:		PROS. STK. WITHOUT TREAT.													

SPECIES _____
 DBH _____
 AZIMUTH _____
 DISTANCE _____ LKS.
 PLOT SLOPE _____
 WOOD NAVAL STORES:
 AVAIL. CL. _____
 NO. STUMPS _____

COMPUTATION OF CULL VOLUMES

[illegible]

SYMBOLS: DEP.--SWEEP DEPARTURE OR CROOK DEPARTURE

% --THE PERCENTAGE OF THE DEFECTIVE SECTION THAT IS CULL

L --LENGTH OF THE DEFECTIVE SECTION IN FEET

S -- THE SCALING DIAMETER OF THE DEFECTIVE SECTION IN INCHES

M -- INCHES MIDPOINT DIAMETER OF THE DEFECTIVE SECTION INSIDE BARK

CONTINUATION OF PLOT TALLIES

TALLY OF LIVE TREES ON VARIABLE PLOT												TALLY OF CUT AND MORTALITY													
AZIMUTH	DISTANCE	TREE NUMBER	DBH	SPECIES	CROWN CLASS	DAMAGE	RADIAL GRO.	GRADE	TREE CLASS	SAWLOG		CORDWD. LGTH.	CULL		OLD DBH CLASS	SPECIES	CUT/MORT.	CAUSE DEATH	TREE CLASS	DBH NOW OR STUMP DOB	HT.OF DOB, FT.	STUMP CLASS	PERIOD (YRS.)	NUMBER OF TREES	
										TOP DIB	LENGTH		BOARD FEET	CUBIC FEET											
		26	-							-	-			-							-	-			
		27	-							-	-			-							-	-			
		28	-							-	-			-							-	-			
		29	-							-	-			-							-	-			
		30	-							-	-			-							-	-			
		31	-							-	-			-							-	-			
		32	-							-	-			-							-	-			
		33	-							-	-			-							-	-			
		34	-							-	-			-							-	-			
		35	-							-	-			-							-	-			
		36	-							-	-			-							-	-			
		37	-							-	-			-							-	-			
		38	-							-	-			-							-	-			
		39	-							-	-			-							-	-			
		40	-							-	-			-							-	-			

CHECKED BY
DATE

ERRORS IN DESCRIPTIVE DATA (SEC. 1)

ERRORS IN PLOT TALLY (SEC. 2)

PLOT OR CREW	TALLY OF LIVE TREES		TALLY OF TIMBER CUT		TALLY OF DEAD TREES	
	MISSED	EXTRA	MISSED	EXTRA	MISSED	EXTRA
NO. IN TALLY % \pm ERROR			TALLY \pm ERROR		TALLY \pm ERROR	

INSTRUCTIONS: USE THIS SHEET FOR CHECKING BOTH THE INDIVIDUAL CREW BY PLOT AND FOR SUMMARY OF THE COMPLETE CHECK BY CREW. THE PRODUCTION PERIOD IS USUALLY THE PERIOD SINCE THE LAST CHECK CRUISE. DAYS ON DUTY INCLUDE ALL EXCEPT THOSE FOR WHICH LEAVE WAS TAKEN. ITEMS IN THE CHECK CRUISE ARE LISTED IN 6 SECTIONS. THE FIRST 5 SECTIONS ARE USED TO ESTABLISH A GRADE AS FOLLOWS: FOR SEC. 1 REDUCE THE MAXIMUM GRADE OF 30 BY THE TOTAL NUMBER OF ERRORS. FOR SEC. 2 REDUCE THE MAXIMUM GRADE OF 20 BY 3 TIMES THE TOTAL NUMBER OF ERRORS. FOR BOTH SEC. 3 AND SEC. 4 REDUCE THE MAXIMUM GRADE OF 20 USING THE EQUATION:

CREW PRODUCTION AND GRADE									
PROD. AND GRADE COMPUTATION	CREW (A, B, C, ETC.)			TOTAL					
CREW PRODUCTION									
CREW-DAYS ON DUTY SINCE _____									
NO. FOREST PLOTS MEASURED _____									
PLOTS PER CREW-DAY ON DUTY _____									
CHECK CRUISE GRADE									
1. DESC. DATA: 30 - NO. ERRORS _____									
2. PLOT TAL.: 20 - 3 X NO. ER. _____									
3. S. L. HT: 20 (1 - $\frac{\text{NO. ER. 4' +}}{\text{NO. TREES MEAS.}}$) _____									
4. CDWD HT: 20 (1 - $\frac{\text{NO. ER. 4' +}}{\text{NO. TREES MEAS.}}$) _____									
5. CULL VOL: 10 - ($\frac{\% \text{BF ER.} + \% \text{CF ER.}}{10}$) _____									
CHECK CRUISE GRADE									
PROD. - ACC. INDEX (PROD X GR)									

$$20 \left(1 - \frac{\text{NUMBER OF TREES WITH HEIGHT ERROR OVER 4 FEET}}{\text{TOTAL NUMBER OF TREE HEIGHTS MEASURED}} \right)$$

FOR SEC. 5 REDUCE THE MAXIMUM GRADE OF 10 AS FOLLOWS:

$$10 - \left(\frac{\% \text{ ERROR BD-FT CULL} + \% \text{ ERROR CU-FT CULL}}{10} \right)$$

IN SUMMARY BY CREW, IDENTIFY CREWS BY LETTERS (A, B, C, ETC.)
IN ORDER OF PROD.-ACC. INDEX.

FIELD PLOT RECORD

Form 7
July 1959STATE _____ UNIT _____
COUNTY _____ CODE _____

PHOTO NUMBER	PLOT NUMBER	LAND USE		PLOT CLASS	OWNERSHIP	AREA EXPANSION FACTOR	PHOTO NUMBER	PLOT NUMBER	LAND USE		PLOT CLASS	OWNERSHIP	AREA EXPANSION FACTOR
		P.I.	GROUND						P.I.	GROUND			
	1							46					
	2							47					
	3							48					
	4							49					
	5							50					
	6							51					
	7							52					
	8							53					
	9							54					
	10							55					
	11							56					
	12							57					
	13							58					
	14							59					
	15							60					
	16							61					
	17							62					
	18							63					
	19							64					
	20							65					
	21							66					
	22							67					
	23							68					
	24							69					
	25							70					
	26							71					
	27							72					
	28							73					
	29							74					
	30							75					
	31							76					
	32							77					
	33							78					
	34							79					
	35							80					
	36							81					
	37							82					
	38							83					
	39							84					
	40							85					
	41							86					
	42							87					
	43							88					
	44							89					
	45							90					

FIELD PLOT RECORD (continued)

Photo number	Plot number	Area factor		P. I.		Ground		Photo number	Plot number	Area factor		P. I.		Ground	
		Inven- tory (Acres)	Timber cut (Acres)	Land use	Owner- ship	Land use	Owner- ship			Inven- tory (Acres)	Timber cut (Acres)	Land use	Owner- ship	Land use	Owner- ship
	91								138						
	92								139						
	93								140						
	94								141						
	95								142						
	96								143						
	97								144						
	98								145						
	99								146						
	100								147						
	101								148						
	102								149						
	103								150						
	104								151						
	105								152						
	106								153						
	107								154						
	108								155						
	109								156						
	110								157						
	111								158						
	112								159						
	113								160						
	114								161						
	115								162						
	116								163						
	117								164						
	118								165						
	119								166						
	120								167						
	121								168						
	122								169						
	123								170						
	124								171						
	125								172						
	126								173						
	127								174						
	128								175						
	129								176						
	130								177						
	131								178						
	132								179						
	133								180						
	134								181						
	135								182						
	136								183						
	137								184						

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